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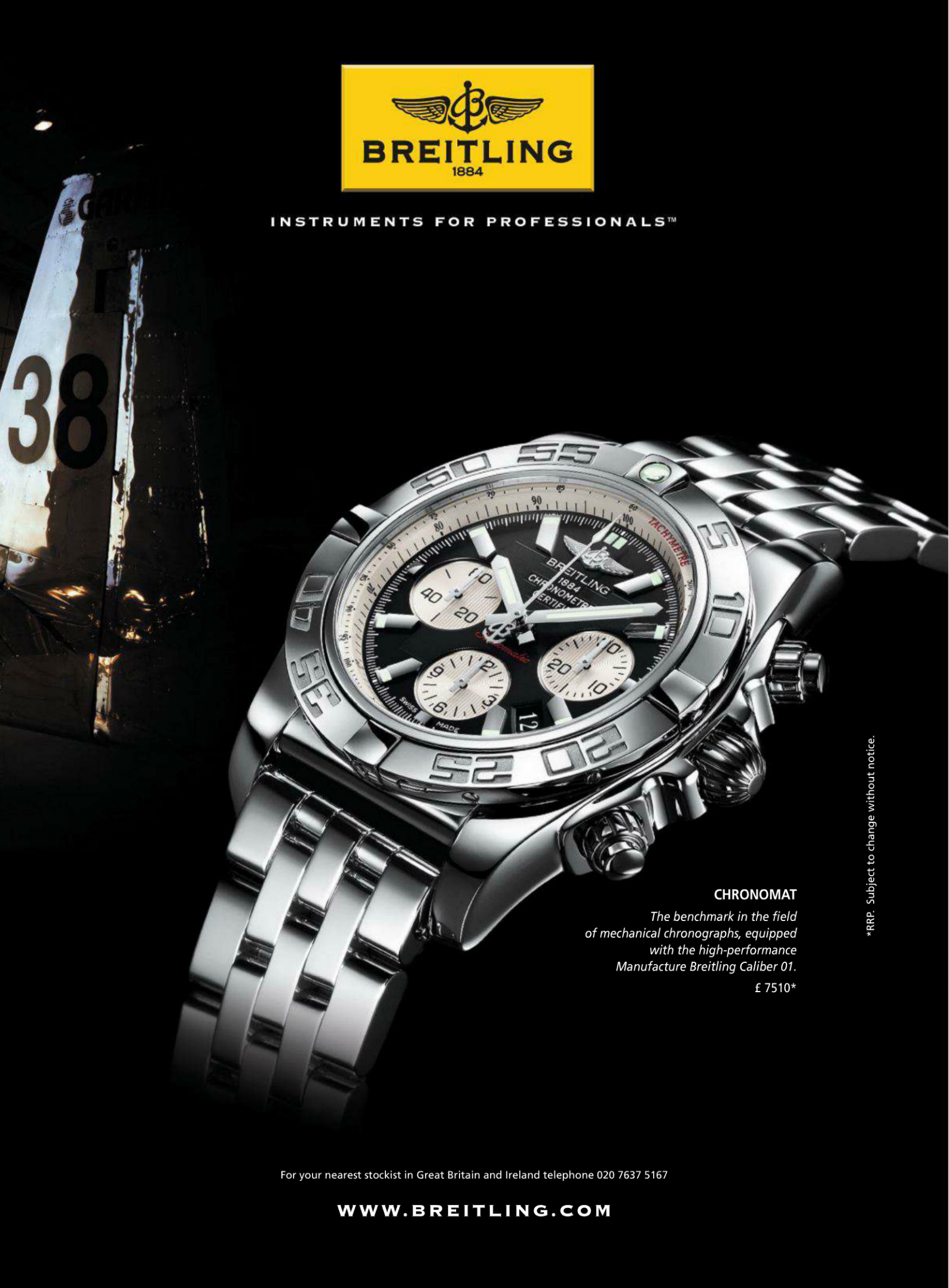
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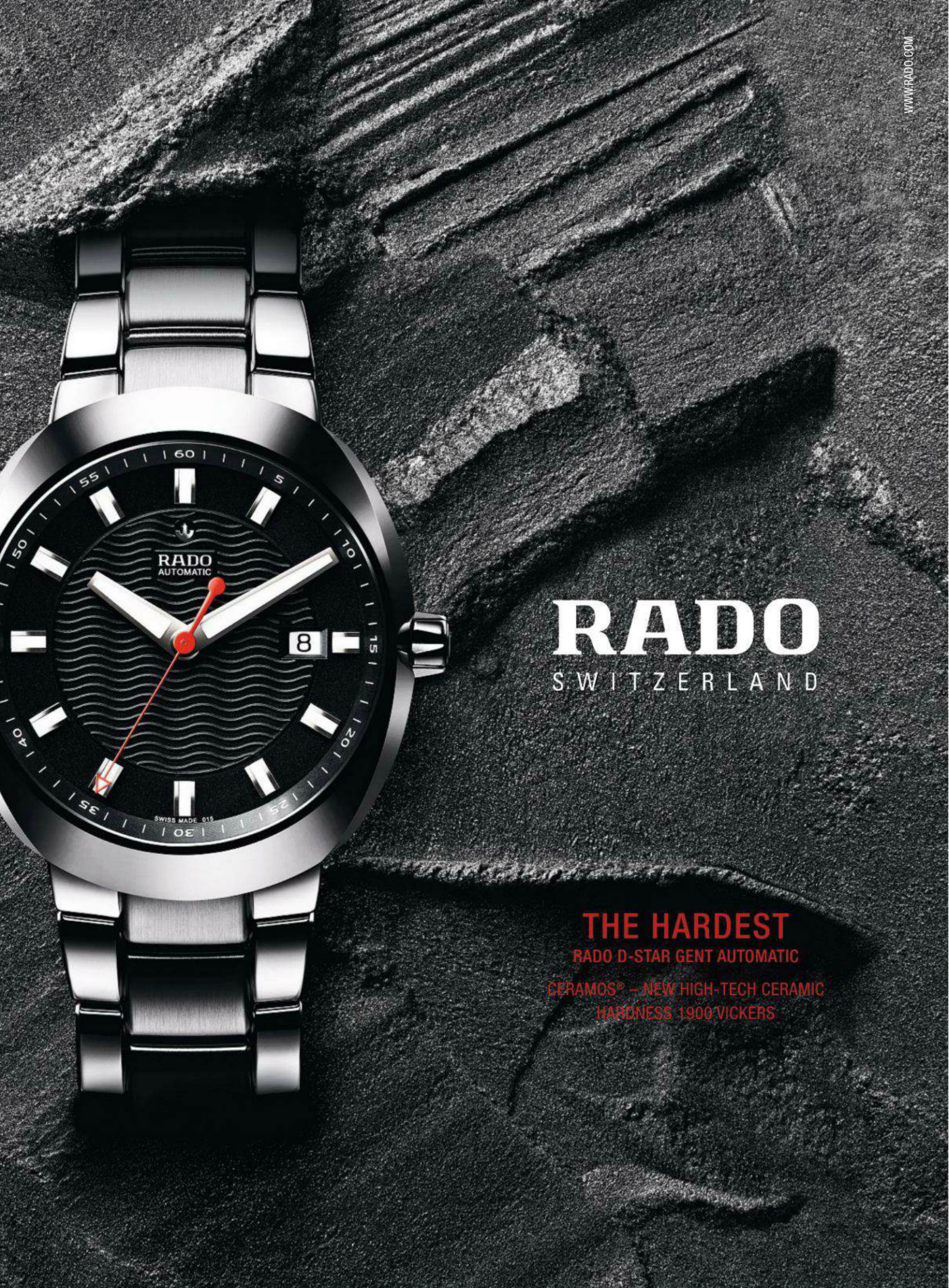
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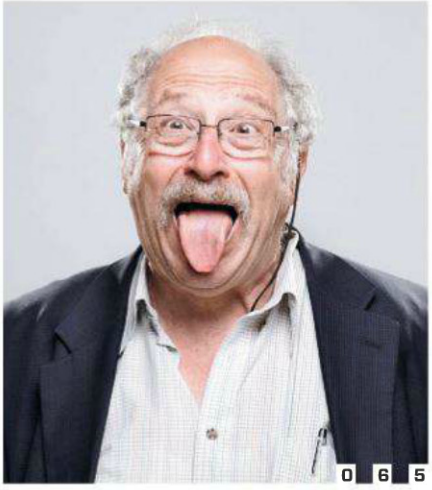

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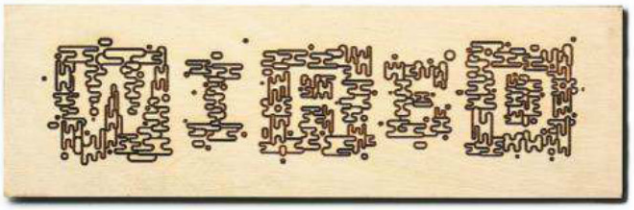

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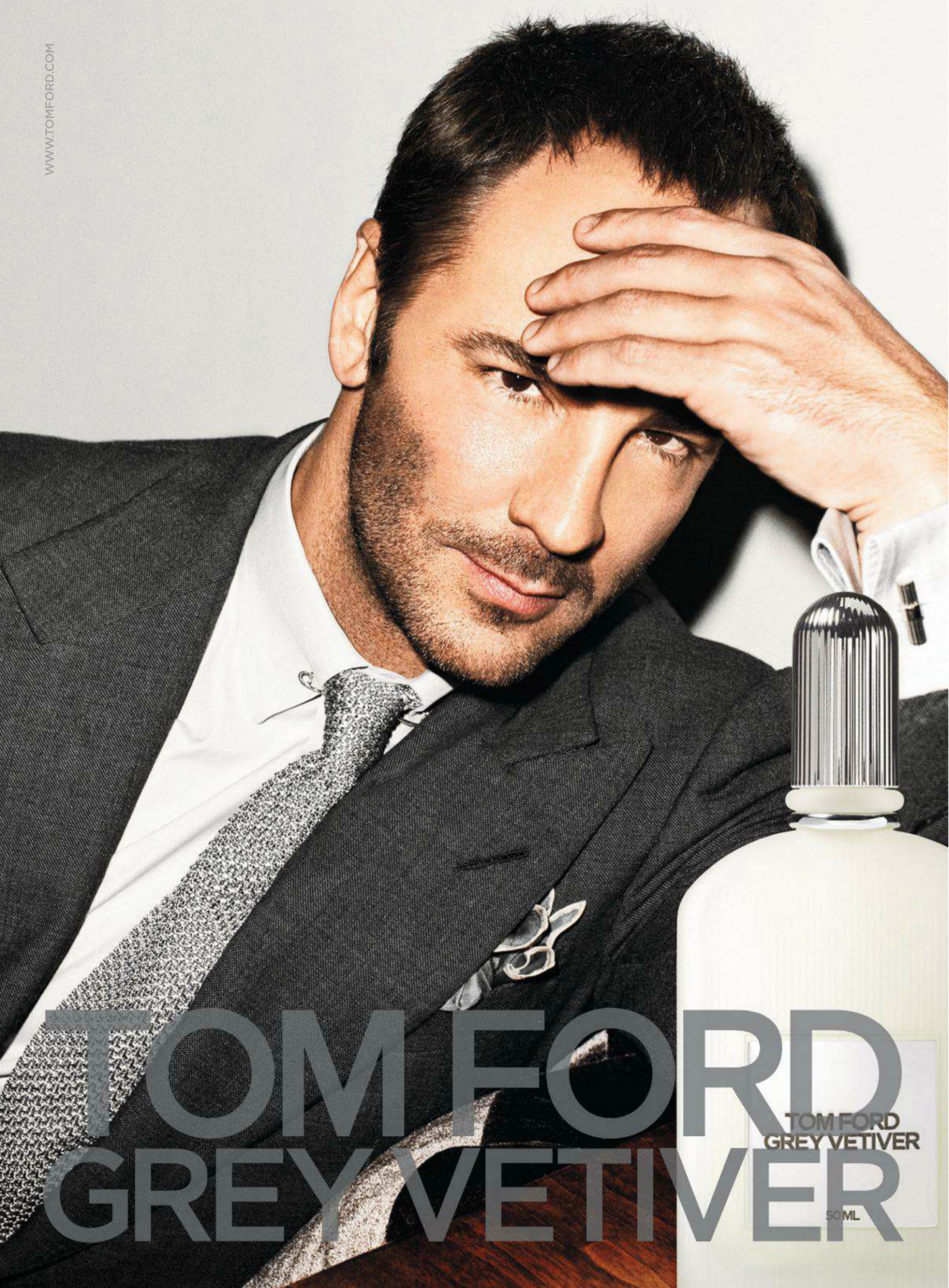
WIRED LOGO: JONATHAN CALUGI, USING CNC CUTTING TO ENGRAVE BIRCH PLY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RANTS

TWEETS FROM THE TOP

Look who made a suggestion for a future WIRED photo feature. That's suggestion with *two* g's, Foreign Secretary...

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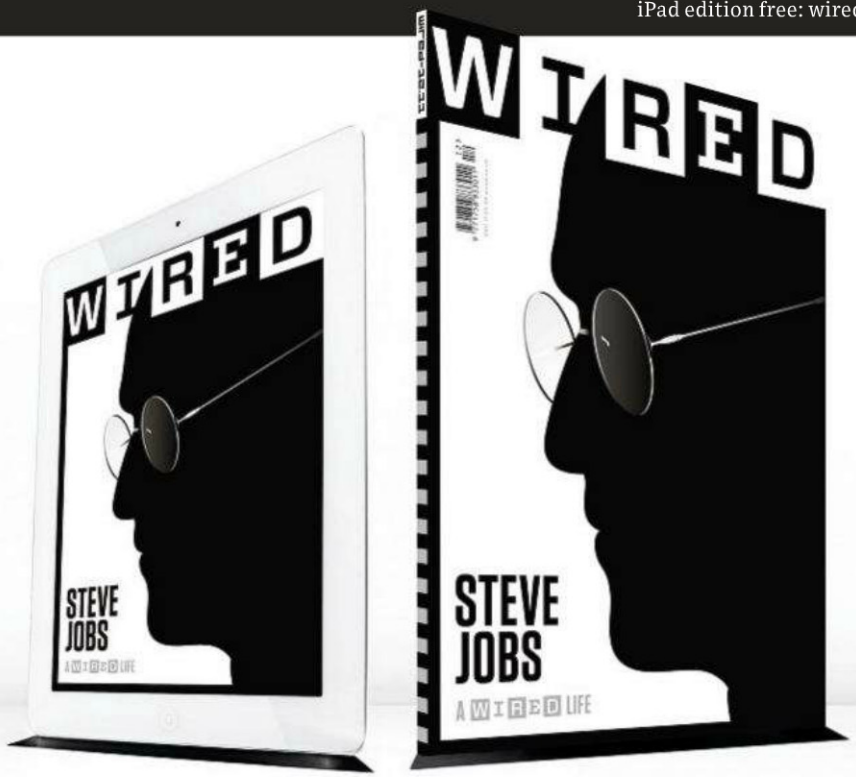

CONFERENCE, CALCULATED

The five most-viewed WIRED 2011 speakers at wired.co.uk

THE 11.11 WORD CLOUD

Knock this cloud down to the three most used words and what do we have? "Just one Apple." A Jobs-worthy signoff.

12.11 Steve Jobs: A WIRED life. To mark the Apple CEO's passing, we thought the most fitting tribute would be a look back at his considerable highs and occasional lows, as reported in WIRED at the time. Recorded Future claimed to predict world events by trawling web data. And 3D printing was documented across eight pages. Are you sold on the idea? Let us know.

DEPTH SENSOR

The first half of WIRED 12.11 is 57 per cent ads interleaved with bite-sized articles, whereas the second half has seven per cent ads dotted among in-depth articles. What would that tell [professor of psychology] Dan Ariely about WIRED's readers?
Brendan McGarvey, via email

You claim (11.11) that James Dyson "rethinks" the science of the appliance. I'm not so sure of his inventive genius. In my work as an architect, I came across a Mitsubishi hand dryer in 2001. Around since the mid-80s, it was near-identical to Dyson's. And I believe the Air Multiplier was aided by an expired 1981 Japanese patent. Dyson has a sharp eye for such expired patents.
G Sarin, via email

WIRED TWEETS

Loving the Steve Jobs cover on this month's *@WiredUK*. Got a feeling it's going to be a geeky tearjerker :-(
@KreativeBomb

Just abt 2 have monthly indulgent bath with *@wiredUK* but when I opened envelope encountered the cover > 2special 4 the tub!
@socialsprout

The *@WiredUK* Steve Jobs feature is one of the most interesting and well compiled I've seen. Makes me want to read the full biography.
@diginate

Got slick new *@WiredUK* last night with shiny Steve Jobs cover. Wondered if they wanted to cut round corners on it too?
@benserbutt

I'm struggling to understand if this present data analysis and cloud stuff is just hype (Why cloud computing is expanding the powers of Big Data analysis, wired.co.uk). What breakthrough has taken place to bring data anaysis to the forefront? Or is it a bunch of social scientists with iPads getting excited, ex post facto, about "data" from interactions, eg: tweets and buying habits?
David Sutherland, via wired.co.uk

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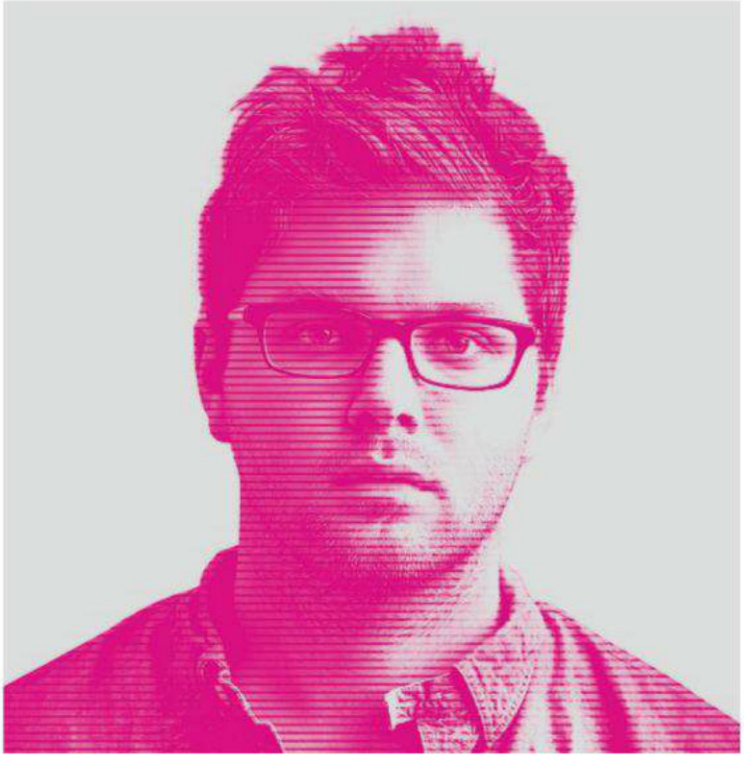

Miller Mobley

Mobley visited New York's Coney Island to photograph Marco Tempest – a magician who mixes magic with technology. "Our world revolves around technology," says Mobley. "It's only natural that it should find a place in magic shows." So, what's his favourite trick? "I love sleight-of-hand magic – I don't think it could ever get old."

Vesa Sammalisto

A Finn in Berlin, 31-year-old Sammalisto provided the epic illustrations for our 25 Big Ideas feature. "I really wanted to go in close on the details," he explains. "The subject suits my style – I aimed to give the reader a breathtaking feeling that there's a lot of interesting stuff going on." We have to agree – his illustrations are every bit as creative as 2012's big trends.

Emily Peck

This month, Peck puts room heaters through their paces in the WIRED test labs. "I always appreciate designs that are eye-catching but practical, full of useful features and easy to use," she says. "Following the philosophy of the great Steve Jobs, my favourite products are ones that I never knew I needed, and can't live without once I've tried them."

Tom Nagy

Nagy took a ride in a driverless car to photograph it for our feature, and found the tech very convincing. "I love driving my car for short distances, but for trips over 200 kilometres, it would be heaven to take a nap and wake up at my destination," he says. "They'd have to create some way for the car to rouse me with a nice, fresh coffee, though..."

Dan Smith

"For something to get on the WIRED playlist, first and foremost it needs to be fun," explains Smith, who curates the Play section's most excitable page. "The best items look awesome and perform their function beautifully. Music, however, gets played to the art desk. It has to receive their seal of approval because they're cooler than me."

Making WIRED

The long and driverless road

Tom Nagy: "We had half a day in October to do the entire shoot. I think it was probably the largest number of images I've ever shot in such a short period – we stopped only once in six hours for burgers and fries. The autoNOMOS guys work incredibly hard – I'm sure they're going to be very rich within the next few years." Looks like the burgers will be on them.

Coney Island's flying fries

Miller Mobley: "I wanted seagulls flying all around Marco [Tempest], so I had the bright idea of buying French fries from a Coney Island vendor. My wife, Jana, stood out of shot and threw fries in the air, and soon hundreds of seagulls were bombarding the photo set. It worked great until a passing biker thought we were throwing food at him..."

PHOTOGRAPHY: TOM NAGY; MILLER MOBLEY

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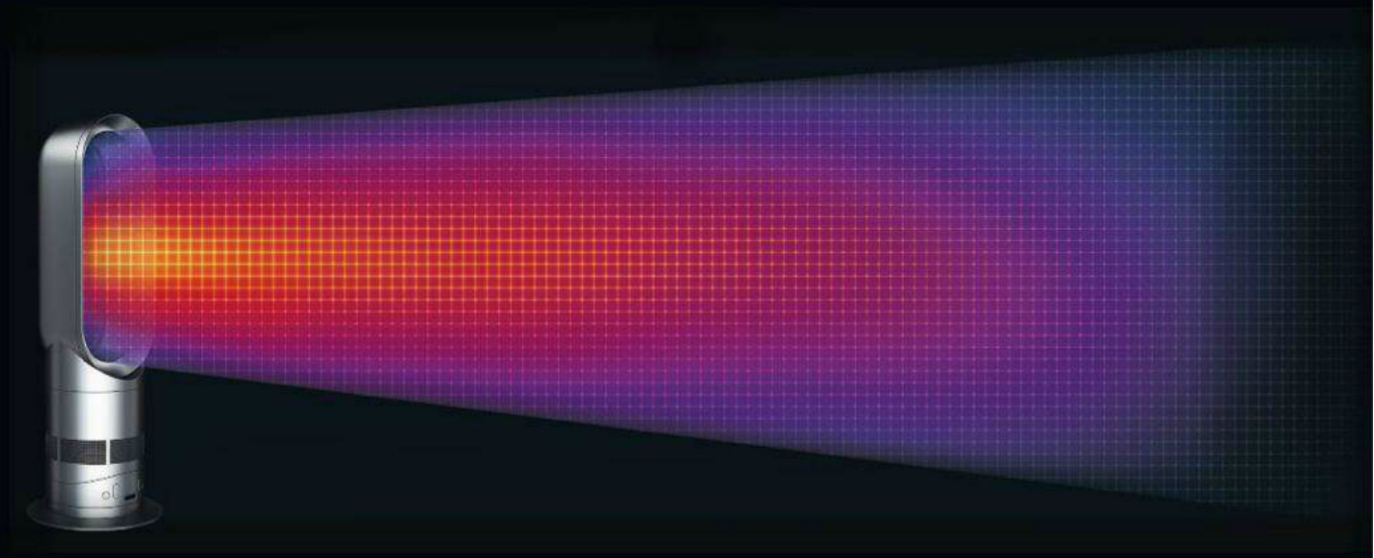

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FROM THE EDITOR

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When Mark Zuckerberg addressed the Paris eG8 conference last May, he explained that soon it wouldn't be just movies, TV, news and books that you discovered through your friends. In fact, the discovery process through the social graph – nurtured by "social design" – will soon affect how you consume everything from travel to clothes. "There's a lot of things like that that tap into the social nature of humans," he said. "This principle of social design is going to be baked into all of these different social applications going forward."

Already there are recruitment firms, retailers, even car manufacturers rethinking their businesses around this notion of social design. If a friend of a friend has a personal experience to share of, say, a room rented on Airbnb, that informs your decisions far more than generic advertising. In Facebook's vision, recommendations via the social graph will soon determine how billions of pounds are spent. And guess which company stands to profit handsomely from owning that discovery platform?

Social design is just one of our 25 Big Ideas for 2012, the third of our annual trend reports that we hope will guide *your* decisions over the next year. From ubiquitous face recognition to neurocinema, our team has researched the technologies and innovations we feel will have an impact in the near future. To understand where our world is moving, we tapped into our wider network of expert friends – from architects to scientists, artists to technologists – and asked them to put their names on the line. Thanks to all of them. It's always exhilarating to get a head start.

Right: Facebook CEO Mark Zuckerberg at the eG8 conference

Great news for subscribers: you now have full access to our iPad edition at no extra charge. At £2 a month in the UK (wired.co.uk/sub) that works out cheaper than the cost of the digital magazine alone – plus you get the paper edition too. We'd like your feedback on the iPad edition, but it's already clear that stories told in video, audio, 360° photographs and touchscreen interactivity will remain one of our many ways to spread the WIRED mission.

David Rowan, Editor

- BSME Art Director of the year, Consumer 2011
- D&AD Award: Entire Magazine 2011
- D&AD Award: Cover 2010
- Maggies Technology Cover 2010
- PPA Designer of the Year, Consumer 2010
- BSME Launch of the Year 2009

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START

NEWS AND OBSESSIONS
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- LCD SCREEN CONSTRUCTION
- ASTRONAUT SCHOOL
- FLYING CARS
- JET FIGHTERS DISSECTED
- SOLAR PHONE-CHARGER

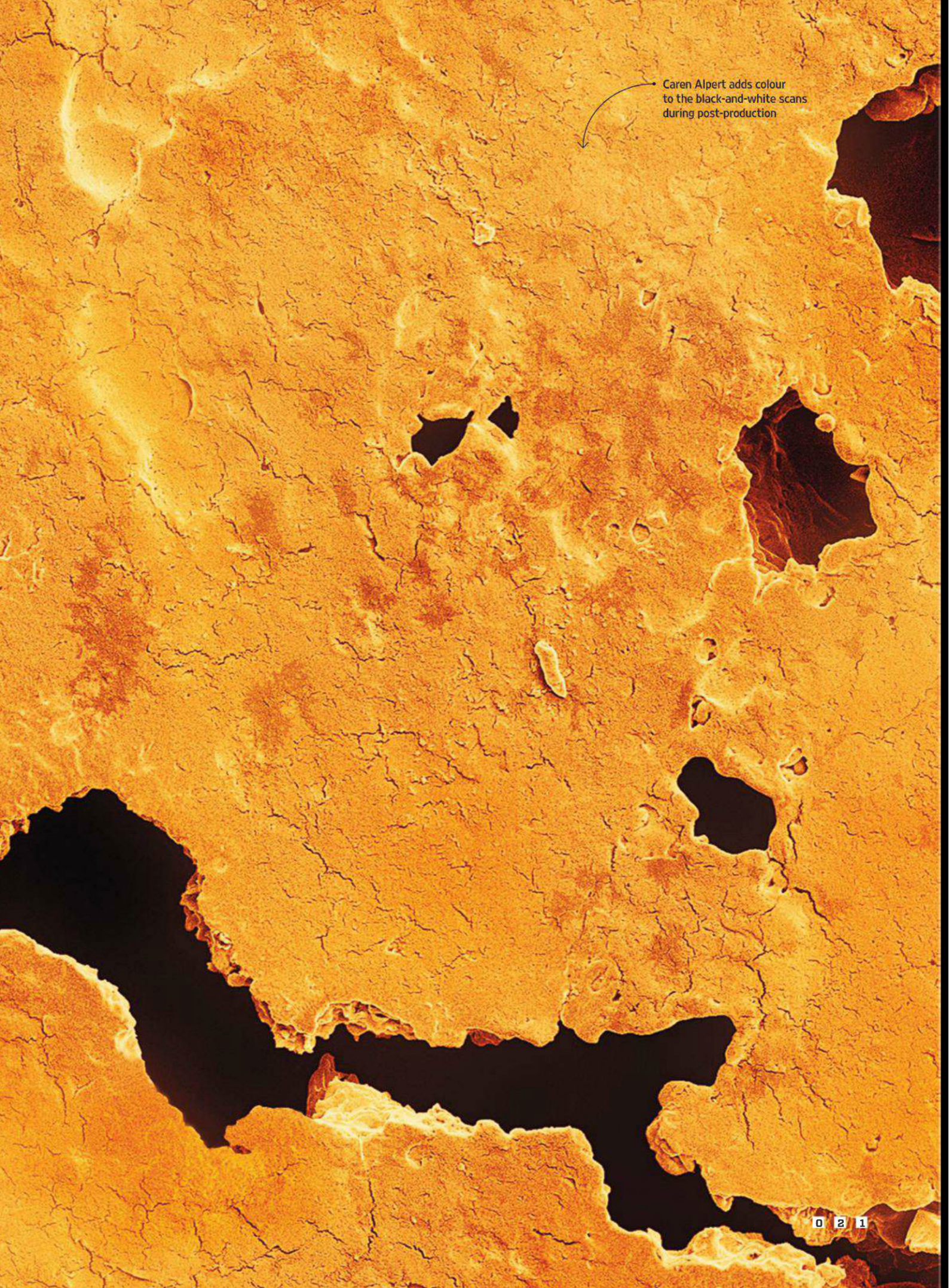
EDITED BY JOÃO MEDEIROS

This is your fortune

A photography project is revealing the alien landscapes secretly residing on our tables

This arid landscape belongs to the Chinese. The Chinese restaurant, that is. It's a fortune cookie magnified 150 times and is part of *Terra Cibus,* a project by Caren Alpert, a photographer from San Francisco. Alpert uses a scanning electron microscope to shoot natural edibles such as fruit alongside processed products to reveal their otherworldly topography. "Organic foods have beautiful textures with a kind of regularity – there's almost a sense of design," she says. "Processed foods have a more irregular, aggressive feel." Some food for thought, perhaps? **Dan Smith** *carenalpertfineart.com*

iPad extra!
Download the WIRED app to see more snacks in macro



Caren Alpert adds colour to the black-and-white scans during post-production

WORLD FOOD PROG

WFP

WHAT'S INSIDE:
WAWA MUM

The 10p lifesaver

Wawa Mum ("good food" in Pashto) is the instant nutrition for survivors of disasters

Supplied by the UN World Food Programme as emergency rations, Wawa Mum provides the daily amino acids, vitamins and minerals essential for children. A 50-gram pack costs ten pence; about 200 tonnes of Wawa Mum have been distributed, providing nutritional support to 136,000 victims.

Each month WIRED's chemist Dr John Emsley deconstructs a product. He is author of 110 research papers and ten books, including his most recent: *Nature's Building Blocks, 2nd edition* (OUP)

INGREDIENTS

Chickpeas
Vegetable oil
Skimmed-milk powder
Sugar
Vitamins A, E, B1, B2, B3, B5, B6, B9, B12, C, D, K
Calcium
Magnesium
Selenium
Zinc
Iron
Iodine
Copper
Phosphorus
Potassium
Manganese
Soya lecithin

CHICKPEAS
The basis of hummus, these are 23 per cent protein, 66 per cent carbs, 5 per cent fat and 3 per cent fibre.

VEGETABLE OIL
This is a source of energy and it also dissolves the oil-soluble vitamins (A, D, E and K).

VITAMINS
Some of those included are B1 (to help against beriberi) and K (to assist in blood coagulation).

ZINC
A deficiency of zinc in the diet leads to dwarfism and delayed sexual development.

IRON
A component of haemoglobin, iron is lost through the walls of our stomach and intestines.

PHOSPHORUS
Present as phosphate ions in the skeleton, phosphorus is in DNA, tooth enamel and insect exoskeletons.

SKIMMED-MILK POWDER
Comprises 36 per cent protein, 53 per cent lactose carbs and 7 per cent minerals.

CALCIUM
In addition to phosphate, calcium is a prime ingredient of bones. Its absence can cause rickets.

SELENIUM
A vital part of antioxidant enzymes, sperm need a lot of it. It's also used in photovoltaic cells.

IODINE
Via the thyroid, this regulates growth and controls body heat. It can also be used to aid leg-ulcer healing.

POTASSIUM
With sodium, this aids the flow of electrical signals along nerves, and is involved in heartbeat regulation.

SUGAR
A pure carbohydrate that's an instant form of energy, sugar can also be turned into bioethanol.

MAGNESIUM
This is required for muscle function, and needed by enzymes. It's found in laxatives and fertilisers.

COPPER
It forms part of several enzymes; some protect against free radicals, others make hormones.

MANGANESE
This is needed by the brain and is part of various enzymes. It is also used to make prison bars.

PHOTOGRAPHY: SCOTT GRUMMETT

Samsung
SMART TV

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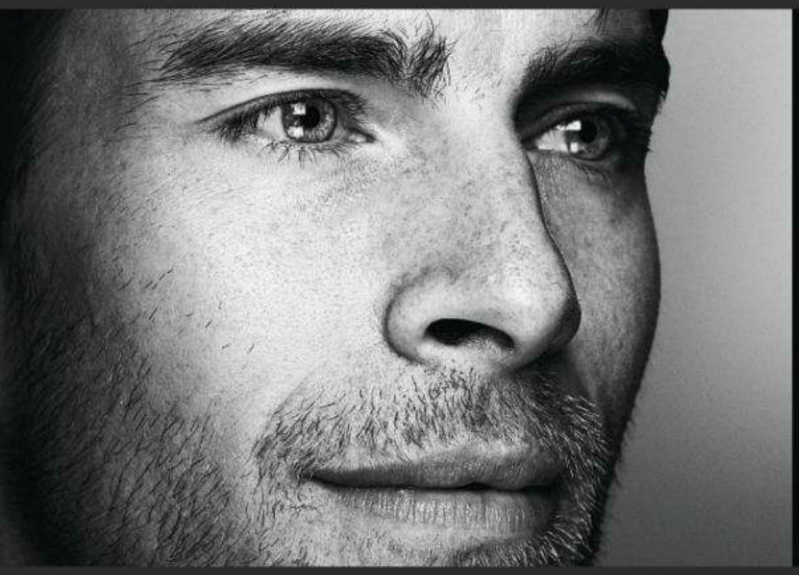

It's stunning, I'm thinking of designing the whole room around it.

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Subscription charge applies to some movies on demand services. Samsung Smart TV features vary by model.

Dell recommends Windows® 7.

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Intel® Core™ i5-2430M processor keeps my shoot running steady without a stall

Display that borders on borderless lets me enjoy larger-than-life classics in a smaller space

Thin design is easy to unpack at airport security

Lets me tuck my entire production studio under one arm.

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intel inside™ CORE™ i5

Planet hunter

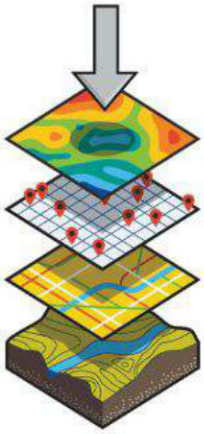
Searching for alternative worlds? It's a living

Lucianne Walkowicz is looking for life outside our neighbourhood. The 32-year-old TED fellow works for Nasa's Kepler Telescope mission, which scans 150,000 stars every 30 minutes. By studying stellar light, Walkowicz can gauge how far a planet is from its star and how habitable it is. In two years of operation, Kepler has found 1,235 planets, including about 50 Earth analogues. "We have to understand how life affects our planet," she says. "That's how we will infer the existence of life."

She is also involved with the Large Synoptic Survey Telescope (LSST), currently being built on a mountain in Chile and expected to be operational by 2015. The LSST will scan the sky every night for ten years to study astral phenomena. It will send around 100,000 real-time warnings per night – about everything from supernovae to stars being ripped apart by black holes – to astronomers around the world. "The big 'wow' for the public has been the Hubble Space Telescope with its images of the cosmos," she says. "But they are static and melancholic because we are looking at something that happened millions of years ago." **JM** *astro.berkeley.edu/~lucianne*

Name: LUCIANNE WALKOWICZ
Occupation: ASTRONOMER
Location: BERKELEY, UNIVERSITY OF CALIFORNIA
Need to know: SHE IS LOOKING FOR ALIEN LIFE AND STUDYING TRANSIENT SPACE PHENOMENA

PHOTOGRAPHY: LIAM SHARP. ILLUSTRATION: KYLE TEZAK



TURNING DATA INTO APPS

The UK government portal for public information, data.gov.uk, offers 5,400 datasets to use as you like. And if you want another, you can just ask. Hundreds of startups, here and around the world, are directing the new intelligence deluge into useful apps. Here are the five on our API. TC

LEVEL BUSINESS
Chris Downs, of London-based Level Business, thinks data should not be expensive. The company provides Companies House accounts and director information to small businesses. *levelbusiness.com*

AMEE
Gavin Starks wants to aggregate the world's environmental and energy data for business intelligence. So far his London-based business AMEE has logged eight million data items. Clients include Google and BP. *amee.com*

DON'T EAT AT
This New York-based app crosses Foursquare with food hygiene: connect it to your Foursquare account and it will alert you if you book at one of the 1,660 restaurants currently under health inspection. *donteat.at*

TUBETAP
If a Tube trip takes 15 minutes longer than Transport for London estimates, you're due a refund. Proving this is difficult, however, without the *TubeTap* app. You can time the journey and request a refund via the app. *tubetap.co.uk*

ZNASICHDANI
This is a hardcore investigative version of the UK's Contracts Finder from Business Link. It reveals the individuals behind the firms that secure state contracts, and calculates the earnings they yield. *znasichdani.sk*

Fly-drive commuting

Wait no longer – the flying car is finally ready for takeoff

For too long, flying cars have been on the same list as jet packs and Moon bases. Glenn Curtiss – chief rival to the Wright brothers – designed one in 1917, as did Henry Ford in 1926. Since then production has stalled somewhat. Now Massachusetts-based Terrafugia is learning how to make flying cars into a profitable business.

"Over the past century, none of the prototypes had any commercial success – most were far too aggressive with their business model," explains Carl Dietrich, CEO of Terrafugia, which was set up in 2006 by a team of MIT graduates. "There was an assumption we'd go from nothing to *The Jetsons* in a year." Its production vehicle, the Transition, is described by Terrafugia as a "roadable aircraft". It can be driven to any public-use airfield with at least 518 metres of runway – and then flown. The interior seats two people plus luggage, and it runs on standard unleaded petrol, with a flight range of 787km.

To prepare the car for flight, the wings extend electromechanically and the engine automatically directs power to the propeller – and yes, you'll need a pilot's licence. To change back to a car, push a button and the folding wings return to an upright position. Power is directed back to the wheels within 30 seconds.

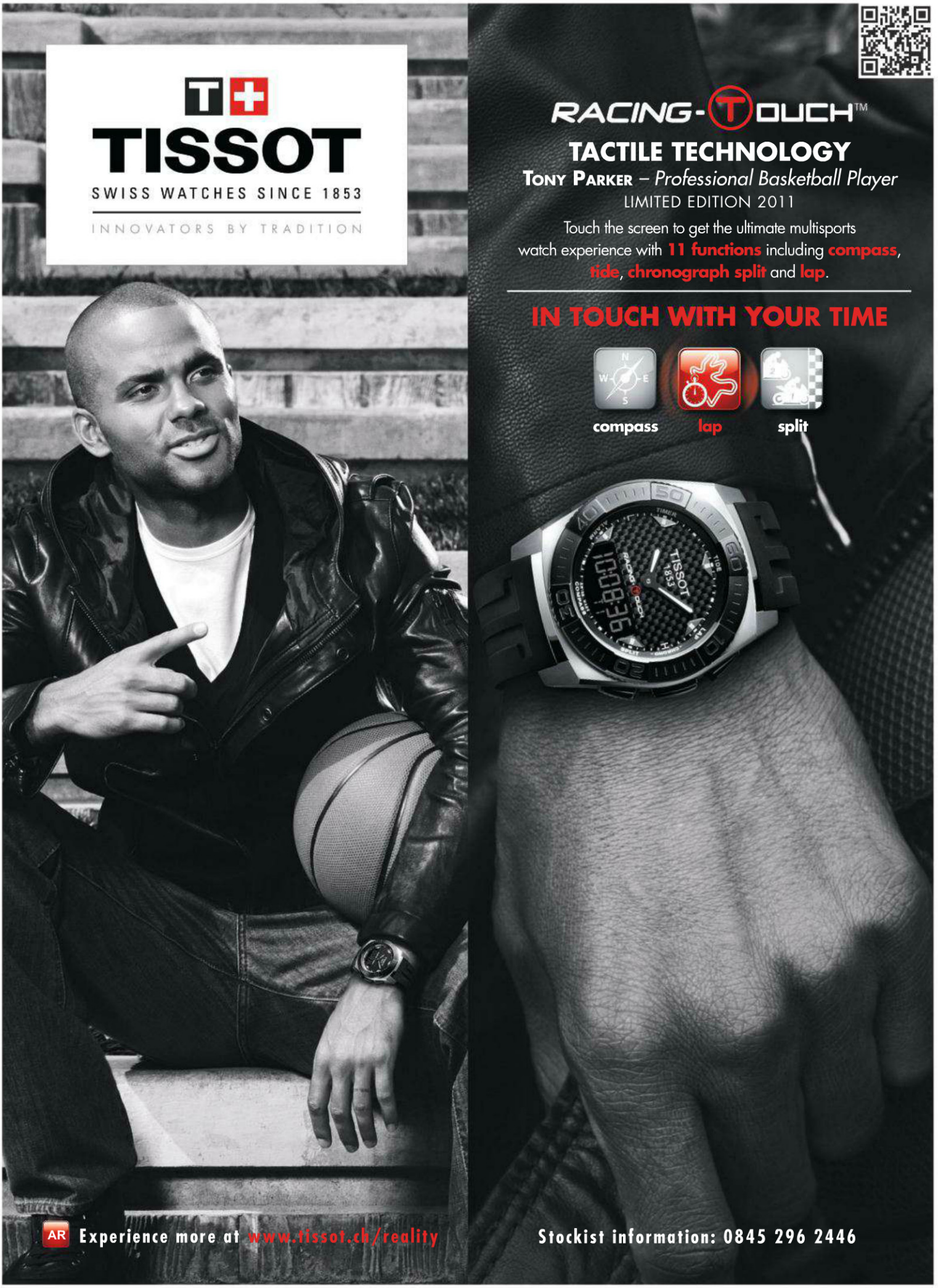
So far, 100 Transitions have been reserved – that's a backlog worth some $25 million (£16m). Terrafugia hopes to begin delivery of the flying cars late 2012, with a starting price around $279,000. Tough UK licensing laws mean the vehicle is only available for US customers, but, says Dietrich, "we're looking into Europe." Goodbye, traffic jams.

Matt Hussey *terrafugia.com*

PLANE FACTS

Road: 14.9km per litre
Flight range: 787km
Airspeed: 172-185kph
Wingspan: 8m
Safety: full-vehicle parachute
Take-off weight: 650kg

On the road, the Transition is a rear-wheel-drive vehicle that is 2m tall, 2.3m wide and 6m long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INFO PORN

Geotagged cities

This illuminating piece of work highlights Europe's online posts

What looks like a satellite-eye view of Europe at night is actually a snapshot of the continent's social habits. Programmer Eric Fischer has mapped our Twitter and Flickr usage by logging geotags from posts: orange dots represent Flickr pictures, blue dots tweets, and white dots indicate where both have been posted.

The California-based mapper used Flickr and Twitter's open application programming interfaces (API) to obtain the locations. "Everything in the maps comes directly from photo and tweet location data – there is no base map that they are plotted on top of." He estimates that he went through 400 maps for the Twitter data – an awful lot of spywork. But did he catch your sneaky tweets? **Matt Hussey**
flickr.com/photos/walkingsf

Flickr users tend to post from scenic locations such as parks and rivers; tweets are spread more evenly

% THE WIRED INDEX

38%

Proportion of Europeans with a mental illness, according to the European College of Neuropsychopharmacology and the European Brain Council

SEVEN

The world's favourite number, based on 13,000 votes on favouritenumber.net

£312 BILLION

How much "non-practising entities", or patent trolls, have cost publicly traded companies in litigation since 1990

47.

Proportion of all photos ever taken that are hosted by Facebook, as claimed by photo-sharing site 1000memories.com

24 HOURS

Period of time University of Maryland students were asked to abstain from using any media. They reported feeling "Anxious, miserable and jittery"

43

Length, in pages, of dress code guidelines at Swiss bank UBS

£187 MILLION

Cost of the Hibernian Express fibre laid between London and New York, to be used for high-frequency trading

6 MILLISECONDS

How much time the new fibre will save on a transatlantic connection

For sources, see page 162

It's make-your-mind-up time

Having too many options leads to brain freeze. Use this formula to work out how long before you can think again

THE EQUATION:

You're standing in the queue for an ice cream, with 50 flavours to pick from, and you want two scoops, giving a total of 1,225 combinations. Are you delighted by such variety? In principle, yes – but in practice it can be overwhelming. You can't make up your mind, and even after making your choice you wonder whether you made the right one. When faced with too many choices, the brain finds it hard to cope, so it takes us longer to choose.

Hick's Law, introduced by the British psychologist William Hick in 1951, describes how long it takes our brains to come to a decision. Essentially it says that every time the number of choices (n) doubles, the time (T) taken to make a decision increases by a fixed amount. This feature is represented by the logarithm to base 2, which mathematically represents the power of 2 needed to obtain the number concerned. So $26 = 2\times2\times2\times2\times2\times2 = 64$ has logarithm 6 to base 2.

Scientists started measuring the time taken to make choices in the mid-1800s, and Hick reinterpreted their results in terms of information theory. Here the base-2 logarithm of a number of choices is the amount of information contained in any specific choice. He conducted experiments using lamps that lit up at random; the subject had to choose which one was lit. His work was developed further by the American psychologist Ray Hyman. A slight modification of the equation, adding 1 to the number of choices, fits data better and can be interpreted as an extra source of uncertainty: whether you should make a choice, as well as which choice you should make.

The constant b depends on the task and the experimental subject. There is some evidence that people with higher IQs have a smaller b, suggesting that one feature of intelligence is a quicker brain. But if you try to impress by choosing your ice cream swiftly, don't be surprised if people conclude that you're just easily pleased. **Ian Stewart**

TREND SURFING

Running with a purpose
Helping both pooches and people, jogsfordogs.com connects recreational runners with pet owners whose dogs need one-on-one exercise. The Good Gym, launched in London's Tower Hamlets, gives people an incentive to lace up: they commit to visiting a less-mobile person when out.

Hook, line & recycle
Vac From The Sea is a conceptual line of vacuum cleaners from Electrolux, which would be made using ocean-waste plastic. Meanwhile, Method – maker of eco-friendly cleaning products – has put this into practice by adding ocean-waste plastic from the Great Pacific Garbage Patch to its packaging.

Food for thought
At Brooklyn-based bar Whiskey Tango Foxtrot, customers pick a spirit and state how they're feeling; the bartender mixes a libation to fit their mood. Romera, a restaurant in Manhattan, is run by a chef who practises "neurogastronomy" – food claiming sensory and emotional impact. **Lisbeth den Toom**

ILLUSTRATION: KARAN SINGH; MATTHEW BILLINGTON

ASUS recommends Windows® 7.

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Space cadets

Want to be a rocket scientist? Head to Kazakhstan to study for your big launch. Photographs by Vincent Fournier

This is where rocket jockeys get their education. The International Space School VN Chelomey is located in the Russian-administered city of Baikonur, in the southern province of Kyzylorda in Kazakhstan. Founded by the Russian Ministry of Education and Science in 1990, this state school caters to 750 students from the age of ten to 15. Baikonur is also home to Baikonur Cosmodrome, the world's largest spaceport, built by the Soviet Union in 1955 and operated today by the Russian Federal Space Agency. The Cosmodrome is also the only spaceport to send crewed missions to the International Space Station. WIRED joins the rocket-science class. **Regina Peldszus** ⟶

AEROSPACE CLASSROOM

The aerospace lecture room is plastered with blueprints of propulsion systems and stacked to the ceiling with cardboard templates of aerodynamic hulls, plastic mockups of spacecrafts, and prototypes. "The students learn the principles of rocket science by designing and launching models," says aerospace teacher Victor Mazepa, 38. The models are made with composite materials and include an engine and a parachute that allows them to be launched and reused.

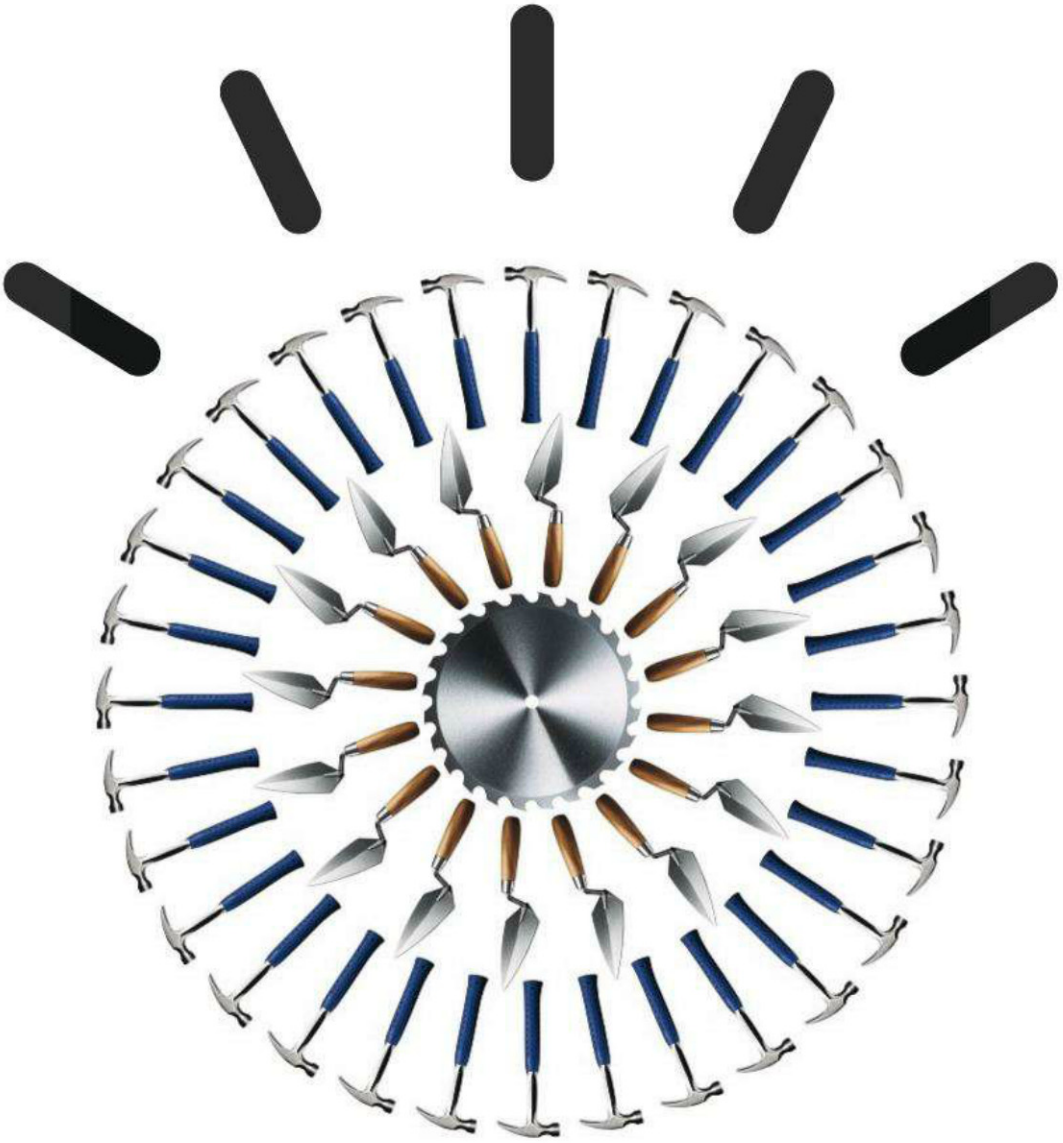
TODAY'S LESSON: BUILD A SHUTTLE

"This is a model of the Buran shuttle [an orbital shuttle like Nasa's Space Shuttle]," says Mazepa. "My ten-year old students build these." Mazepa also coaches his class during rocket modelling contests.

SEMYORKA R-7 MONUMENT

One of Baikonur's main avenues is home to a full-scale mock-up of the Semyorka R-7. The 34-metre, 280-tonne missile was made by the Soviets during the cold war and was the world's first intercontinental missile system. ⟶

PHOTOGRAPHY: VINCENT FOURNIER



How a midsize construction company built a new client base.

In order to thrive on a smarter planet, midsize businesses need the ability to discover and take advantage of new growth opportunities as quickly as they happen. Take VCC, for instance; based in Arkansas, this 225-person construction company saw an opportunity to expand beyond their core retail construction business into healthcare and public sector projects. The key to their expansion was mobility; for VCC to succeed, project managers needed the ability to generate new leads on the road. So, they turned to iEnterprises, an IBM Business Partner, to develop a smart-phone enabled customer relationship management (CRM) solution based on IBM collaboration software. Having mobile access to sales leads, contacts, proposal databases and other vital information helps enable project managers to pursue a new business opportunity at a moment's notice. The solution resulted in a 40% increase in new business, and saved an average of 400 employee hours per month. To see how IBM and our Business Partners can help your midsize business work smarter, visit **ibm.com**/engines/uk/construction. Let's build a smarter planet.

Midsize businesses are the engines of a Smarter Planet.

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IN THE MUSEUM
These models in the aerospace lecture room are built by the students. They include a replica of the Buk anti-aircraft missile, and a rocket model made from a plastic bottle, launched using water and pressurised gas.

LIVE PLAYGROUND EXPERIMENTS
In the yard stands a bust of Vladimir Chelomey. Chelomey was a mastermind of the Soviet spaceflight programme during the 60s; he designed satellites and the Proton space rocket, still in use today.

PHOTOGRAPHY: VINCENT FOURNIER

WIRED	TIRED	EXPIRED
Inspector Spacetime	*Wormhole X-Treme!*	*Tales of the Black Freighter*
New Aesthetic	Steampunk	Cyberpunk
Drone malware	Smartphone botnets	Word macro spam
Touchscreen gloves	iPad jackets	Earphone beanies
Open newslists	Open data	Open source

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INDEPENDENT

* Data on file, referring to E-P3, Olympus Inhouse Test, June 2011. ** offer not applicable to Olympus E-PL1.

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All-in-One PC ET2410 Series, available in 23.6" large screen sizes, suits your needs perfectly. From its elegant design with great curves all around and advanced features to the easy and fun-to-use optional multi-touch screen, ET2410 Series will become the centrepiece of your family's entertainment. Plus, the elegant pedestal design provides effortless tilt adjustment and superb stability.

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Powerful bass Subwoofer*

Super Sharp

The 23.6" 16:9 Full HD LED screen of the ET2410 delivers more details of the high definition content; brings you more pleasure while playing games or watching movies. Its super-sharp colours enhance your high-definition entertainment, graphics-intensive creative tasks, productivity applications, gaming adventures and Internet surfing. ET2410 Series features HDMI input/output, making it easy and convenient to project video content, or convert for a separate display.

Watch TV*

Watch TV anytime instantly, whenever you feel the need. ET2410 Series plays video at true 1080p resolution and features a built-in hybrid digital/analog TV tuner, making it an ideal TV replacement. You can even connect a second display via HDMI out. *Selected models

Built-in BLU-RAY Combo*

With pristine HD resolution and stunning clarity, Blu-ray Disc™ technology is the ultimate way to enjoy your entertainment. You can even burn your videos to DVD media to share with your family and friends. *Selected models

Latest NVIDIA Graphics

Armed with a powerful NVIDIA GT450M graphics card with 1GB VRAM, select ET2410 Series handily render intense HD video and large files without placing huge demands on the CPU. ET2410 Series also makes use of their 802.11b/g/n wireless with an integrated webcam and microphone to keep you connected to your family and friends.

•External subwoofer, TV tuner, and multi-touch are available on selected models only.

SonicMaster Hi-Fi Audio Technology

Fine-tuned for crystal clear sound

dts Surround Sensation UltraPC

2x the impact than other technology

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ASUS recommends Windows® 7.

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Bring live performance home and fill your space with acoustic wonder

Powered by SonicMaster, DTS Surround Sensation and a bundled external subwoofer, the ET2410 immerses you in powerful bass, spacious sound and crystal clear audio. Combined with a 2nd generation Intel® Core™ processor, genuine Windows® 7 Home Premium, NVIDIA® graphics and a brilliant 23.6" Full HD display, your entertainment shines on the ASUS ET2410.

intel inside CORE i5 Visibly Smart

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External Subwoofer

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Optical multi-touch control

Built-in TV tuner

HDMI in/out
Use it as a monitor

Where TV screens are born

Making an LCD display? Applied Materials has a 100-step programme – which starts like this...

You may not have heard of Applied Materials, but you've almost certainly used a device built on its machines. For four decades, the US-based company has supplied the systems that produce integrated circuits for some of the best-known technology manufacturers, including IBM, Intel and Sony. Its R&D budget for 2010 alone topped $1 billion (£625 million). "Almost every LCD panel made comes through one of our systems," says general manager John Busch. "For TVs, that's a couple of hundred million dollars a year – with mobile phones it's more than a billion."

The monster machine pictured below is the AKT-PiVot flat-panel system, based at the company's demo room in Alzenau, Germany. It adds layers of conductive material to glass sheets which become the circuitry for LCD screens. "There are probably a hundred different steps in the factory," says Busch. "This is just one of them." **Dan Smith**

START HERE...
To follow the LCD-screen-construction process, start far right and work backwards. Why? Consider it a nod to the Asian markets it's developed for.

VACUUM ROTATION MODULE
Two tracks pivot around a central axis, rotating the substrate into position to move it to the next available chamber, or to one of two chambers on the other side. This speeds up production and is where the machine's "PiVot" name originates.

POWER CABINETS AND PUMPS
These large cabinets house the power controls and computers that run the AKT PiVot. To the right are the rough pumps, which control air pressure in the load locks. The high-vacuum pumps are the three black "handles" on each deposition chamber.

DEPOSITION CHAMBERS
A 30nm-thick layer of molybdenum (or "moly") is applied to the substrate, followed by a layer of aluminium, which will conduct electrical current in the working screen. A second moly layer is then added to the sandwich to protect the aluminium.

PRIMARY/SECONDARY LOAD LOCKS
In the first chamber, pressure is pumped down to create a near vacuum similar to the atmosphere on Pluto's surface. The second lock increases pressure to nine times below Earth's atmosphere. This ensures no unwanted particles contaminate the substrate.

LOADING THE MACHINE
Every minute a 2.2m x 2.6m glass sheet (or substrate) is loaded onto the AKT-PiVot. Eight 46" screens or six 52" screens can be produced from each load, in around seven minutes. On exiting, the substrate is sent for lithography and etching.

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Pioneer car

www.pioneer.co.uk/car

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Put a cork in it, scientists

How researchers study extreme undersea environments without destroying them

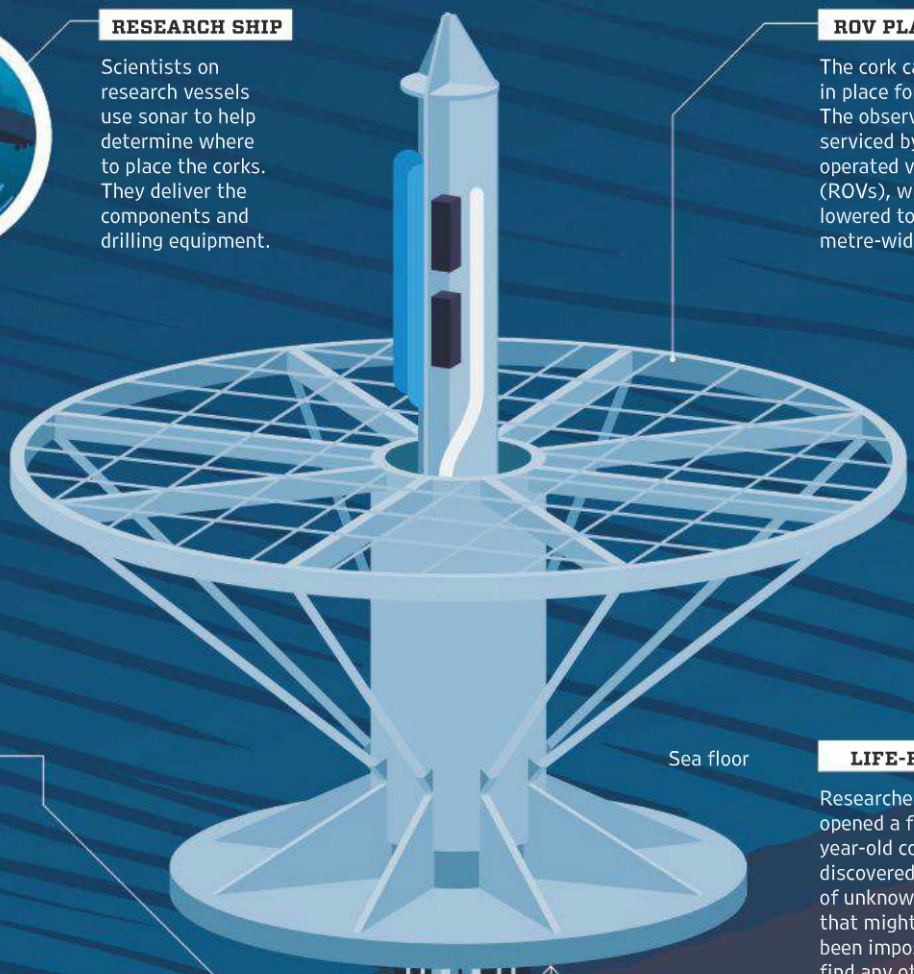
Far below the ocean's surface lies one of the most inhospitable habitats on the planet. Deep inside subterranean cracks, where seawater seeps through the perpetually hot rock in Earth's crust, there's a surprisingly rich ecosystem of microorganisms. Scientists have long been eager to study these creatures – along with the larger geological setting – but drilling holes in the sea floor large enough to drop instruments down floods the habitat with cold water, killing off the fauna. That's where a type of rig called a Circulation Obviation Retrofit Kit – or "cork" – comes in. Researchers install these observatories in boreholes, with a two-storey-tall wellhead that forms a seal to protect the environment below – and a half-kilometre or so of instrumentation. Here's how. **Erin Biba**

RESEARCH SHIP

Scientists on research vessels use sonar to help determine where to place the corks. They deliver the components and drilling equipment.

ROV PLATFORM

The cork can be left in place for ten years. The observatory is serviced by remotely operated vehicles (ROVs), which are lowered to its four-metre-wide platform.



BOREHOLE

The 1km-deep hole is dug in stages and stabilised with concentric steel casings, sealed with cement and rubber. The cork is then placed over the hole.

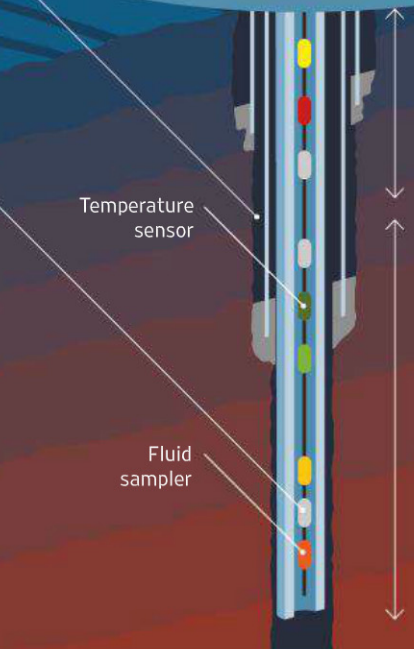
Sea floor

LIFE-FORMS

Researchers recently opened a four-year-old cork and discovered a colony of unknown microbes that might have been impossible to find any other way.

INSTRUMENTS

Sensors and sampling devices are positioned throughout the cork's shaft to measure water pressure and temperature, and to collect samples.



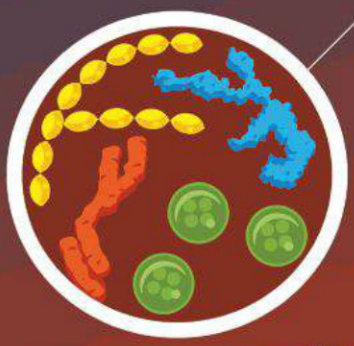


ILLUSTRATION: JAMES PROVOST

Fuelling change

The portable phone-charger that soaks up data and free sunshine

Berlin-based start-up Changers is taking action against climate change – and they're starting with phone charging. "If everyone contributes a little, we can alter behaviour," says Hans Raffauf of Changers. The company has developed a solar-powered phone charger that measures energy production and shares the data with others.

The $149 (£93) Changers starter kit contains the "Maroshi" A4-size solar panel, and the "Kalhuhfummi" lithium-ion battery unit. It charges up in four hours of sunlight, measuring each Watt-hour of energy produced and gram of CO_2 saved. The data can be uploaded to the Changers site and compared with that of other users. Need a further incentive? Every green Watt-hour earns you a credit or discount voucher for partnering businesses.

Beta-testing of the device started in California last autumn; Europe will begin testing early this year. **Jeremy Kingsley** *changers.com*

The unit can store data gathered over 42 days of solar charging

CHARGE
iPhone
iPad
Android phone
Nintendo DS
Kindle

PHOTOGRAPHY: SAM ARMSTRONG

SCREENED NEW & USEFUL THIS MONTH: ORGANISER APPS

Evernote Read and write notes, gather web clippings and more, then sync them on devices which use the *Evernote* app. Take that, Moleskine. *iOS, Android, Windows Phone, BlackBerry and others, Free*

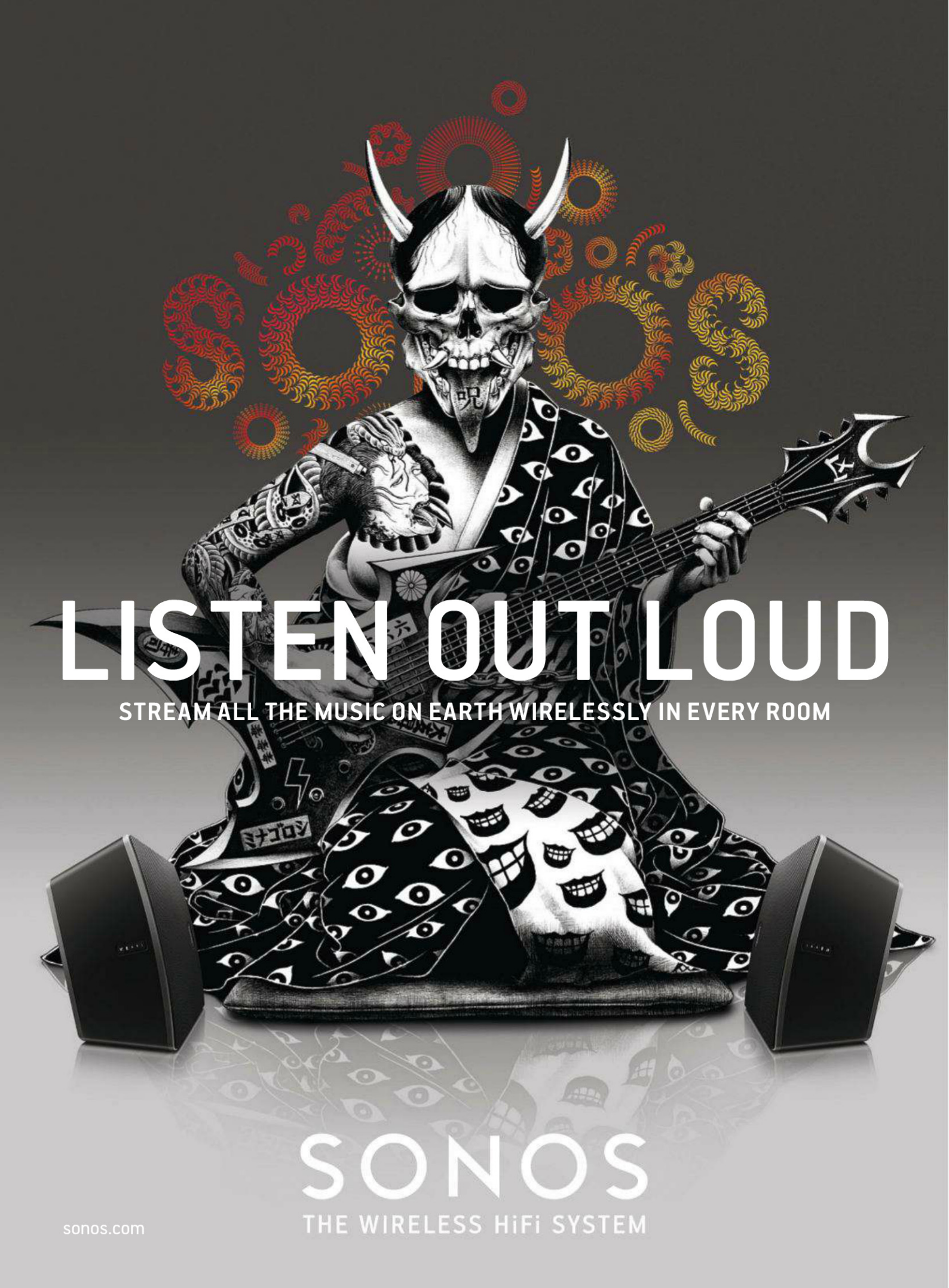
Wunderlist An elegant organiser that syncs your past, present and future to-dos across your phone, computer and tablet. In fact, downloading it should be at the top of your next list. *iOS, Android, PC , Mac, Linux, Free*

2 Sugars Do you have a coworker who likes their coffee above-medium strength with 0.7 teaspoons of sugar? Us too. This app helps you remember the preferences of such pedantic coffee consumers. *iOS, £0.69*

CamCard Lite This app takes the data-rich device known as the business card, and puts its contents into your phone's address book via a quick cameraphone snap. *iOS, Android, BlackBerry, From free*

Password-Gear Using "123456" as a password is like handing your details to the hackers. *PasswordGear* will generate a super-secure password and help you remember what it is. *iOS £1.49*

Did I Close The Door? Obsessive door-closers, this app is for you. Log the time and date of nine doors you've closed, and end nagging doubts over whether you shut the back one (you didn't). *iOS, £0.69* **Nate Lanxon**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LAB NOTES #14

At last, you can blame the weather

The weather doesn't just determine if we should be wearing a thick coat or not – it can have profound effects on the way we behave.

You're warmer and colder towards people depending on the weather. In studies, warmer conditions induced: greater social proximity; use of more concrete language; and a more relational focus.[1]

People shop more on sunny days: as exposure to sunlight increases, negative effects decrease and consumer spending tends to increase...[2]

...And work more when it pours: on rainy days, men shift on average 30 minutes from leisure to work.[3]

The weather can affect which university you pick: an increase in cloud cover of one standard deviation on the day of the visit is associated with an increase in the probability of enrolment of nine percentage points.[4]

It also affects job interview performance: "We analysed the results of consecutive medical-school interviews at the University of Toronto between 2004 and 2009... Those interviewed on rainy days received a one per cent lower score than those interviewed on sunny days... The difference in scores was equivalent to a ten per cent lower total mark on the Medical College Admission Test."[5]

And although you may wish for warm summer days, be careful – fists fly when it's hot outside: field studies clearly show that heat increases aggression.[6]

Eric Barker *bakadesuyo.com*

For sources, see page 162

From Russia with uranium

Bombs power the US homes they were meant to destroy

The end of the cold war created a problem: what to do with the USSR's stockpile of nukes. The solution: a 1993 agreement to convert 500 tonnes of Soviet weapons-grade uranium into fuel for American nuclear plants. Russia got paid, the US got power and scientists who might otherwise have gone rogue got jobs. Former warheads now fuel about ten per cent of the electricity that the US consumes. When the programme finishes in 2013, the equivalent of 20,000 Soviet missiles will have been repurposed to light the same homes that they were built to annihilate. Here's how it's being done. **Damon Tabor**

DISMANTLE

Russians have classified some of this process, but it's likely that technicians at disassembly plants in four cities, including the once-secret Sverdlovsk-45, remove the missile casing and separate the high explosives (which would have been used to set off the nuclear reaction) from the highly enriched uranium.

OXIDATE

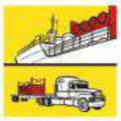
Uranium is shipped by rail or truck in sealed containers to plants at one of two "closed" cities: Seversk or Ozersk. There, the material is machined into metal shavings with a lathe and roasted at 1,000°C in an ovenlike box. This oxidises the metal and converts it to highly enriched uranium-oxide powder (U_3O_8).

FLUORINATE

At Seversk or the Electrochemical Plant in central Russia, the U_3O_8 is injected into a flame reactor. This combines the powder with gaseous fluorine to produce highly enriched uranium hexafluoride (UF_6), a white crystal resembling rock salt.

BLEND

To transform the weapons-grade material into nuke fuel – called downblending – a T-pipe unit heats the crystalline UF_6 to a gas and mixes it with 1.5 per cent low-enriched uranium gas. The resulting substance is about 5 per cent low-enriched uranium-235 – bad for bombs but great for nuclear plants.



TRANSPORT

The final product is loaded into super-sturdy 2.5-tonne steel containers, shipped by rail to Saint Petersburg, transported by cargo ship to Baltimore, and trucked to a uranium-enrichment facility in Paducah, Kentucky. After testing, it's sold to companies that turn the material into fuel rods.

PHOTOGRAPHY: GETTY. ILLUSTRATIONS: JAMESON SIMPSON; DALE EDWIN MURRAY

Lenovo® recommends Windows® 7.
intel inside
CORE i7
Visibly Smart
NEW SEASON COLLECTION | 1000 THINGS TO COORDINATE | SLIP-UPS NOT AN OPTION
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A one-man metal band

This purveyor of industrial doom is powered by Arduinos and anguish

By day, Tristan Shone builds custom add-ons for electron microscopes at the National Center for Microscopy and Imaging Research in San Diego. By night, the 34-year-old performs industrial doom and drone metal under the guise of Author & Punisher.

Shone (*below*) designed and built each of his Arduino-powered instruments: at his left hand is "Rack & Pinion", a keyboard that allows him to warp samples by sliding six velocity-sensitive keys along Teflon-coated pipes. His right hand pumps "Rails" back and forth like a slide trombone, or spins the aptly named "Big Knobs". All the time, he's also singing into an array of eight microphones called "Headgear".

But it's not all rock 'n' roll – the real challenge is making sure the wires don't pop out of the microcontrollers. "Whether it's the things I make at my day job or for my music, 99 per cent of the time, the problem is wiring," explains Shone. Perhaps that's what fuels his rage in such sweet ditties as "Terrorbird" and "Sand, Wind and Carcass"? **Bryan Gardiner**

PHOTOGRAPHY: JEREMY AND CLAIRE WEISS

THE BIG QUESTION

"HOW WILL LIFE IN CITIES BE DIFFERENT IN THE NEXT DECADE?"

RICHARD FLORIDA,
SENIOR EDITOR,
THE ATLANTIC

"Cities are the greatest expression of human civilisation. We come together in cities to live, work, play and create. Without question, cities are the primary social and economic organising units of our time."

CAROL COLETTA,
PRESIDENT,
ARTPLACE

"The trends are clear: less sprawl, more intensity, smaller format stores, more biking, more walking, more public space, less private space. The hybridisation of space, jobs and neighbourhoods will connect people in new, unexpected ways."

SASKIA SASSEN,
PROF. OF SOCIOLOGY,
COLUMBIA UNIVERSITY

"Two extremes: the Mega City with vast slums, and the Intelligent City. Slums will be full of working people and fighting gangs, and be 'uncensored'. 'Censored' cities dilute the political and the capacity of cities to make history."

JAKE BARTON,
FOUNDER, PRINCIPAL,
LOCAL PROJECTS

"The physical city won't change much, but our experience will be so hyperoptimised by the convergence of data-, mobile- and location-aware services, that our daily lives will be transformed. But how will being optimised really feel?"

JEANNE GANG,
PRINCIPAL, STUDIO
GANG ARCHITECTS

"Cities and suburbs will learn to accommodate simultaneous live/work spaces for informal economies, and will learn to create the required energy from something we seem to have no problem producing – sewage and rubbish." **Maria Popova**

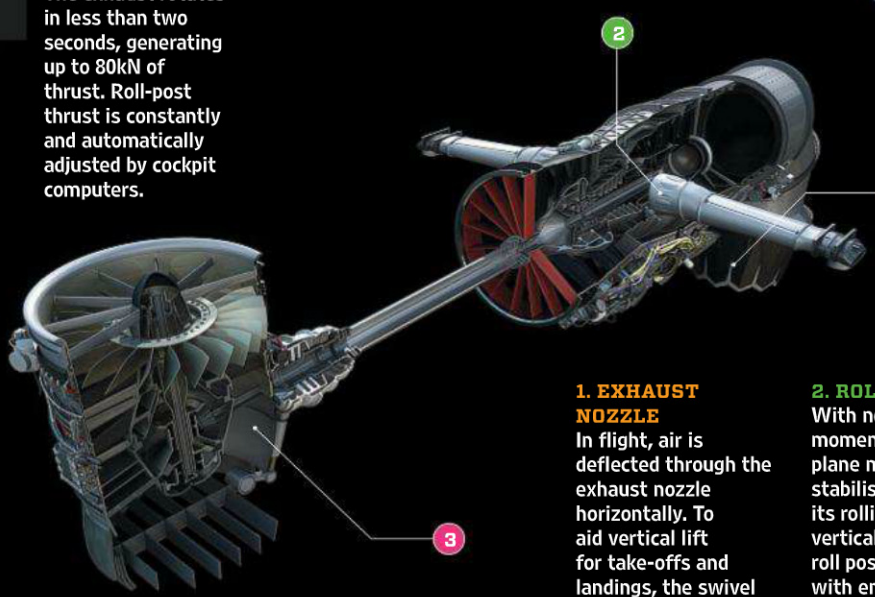
Prepare for vertical landing

The next-gen F-35B jet has an arsenal of supersonic surprises under its hood

Successor to the Harrier, the F-35B is the short-take-off/vertical-landing (STOVL) variant of Lockheed Martin's next generation of supersonic fighter jet. Faster, easier to manoeuvre, and engineered for optimum stealth, it's due to enter service in 2016. The Rolls-Royce LiftSystem is the UK-engineered technology behind its vertical gymnastics: it holds the 25-tonne jet in the air with 186kN of vertical thrust and controls its drop from the sky. **Jeremy Kingsley** *www.jsf.mil*

HOW IT WORKS
Where typical fighters require around 900m of runway, the F-35B needs just 91.5m. First the engine faces backwards to pick up horizontal speed, and at 41m/s the exhaust nozzle turns downwards and aids the lift-fan in pushing the plane up into the air. For vertical landings, the engine throttles backwards, before driving 28,000bhp to the lift-fan and exhaust nozzle, with roll posts keeping the plane level in its descent.

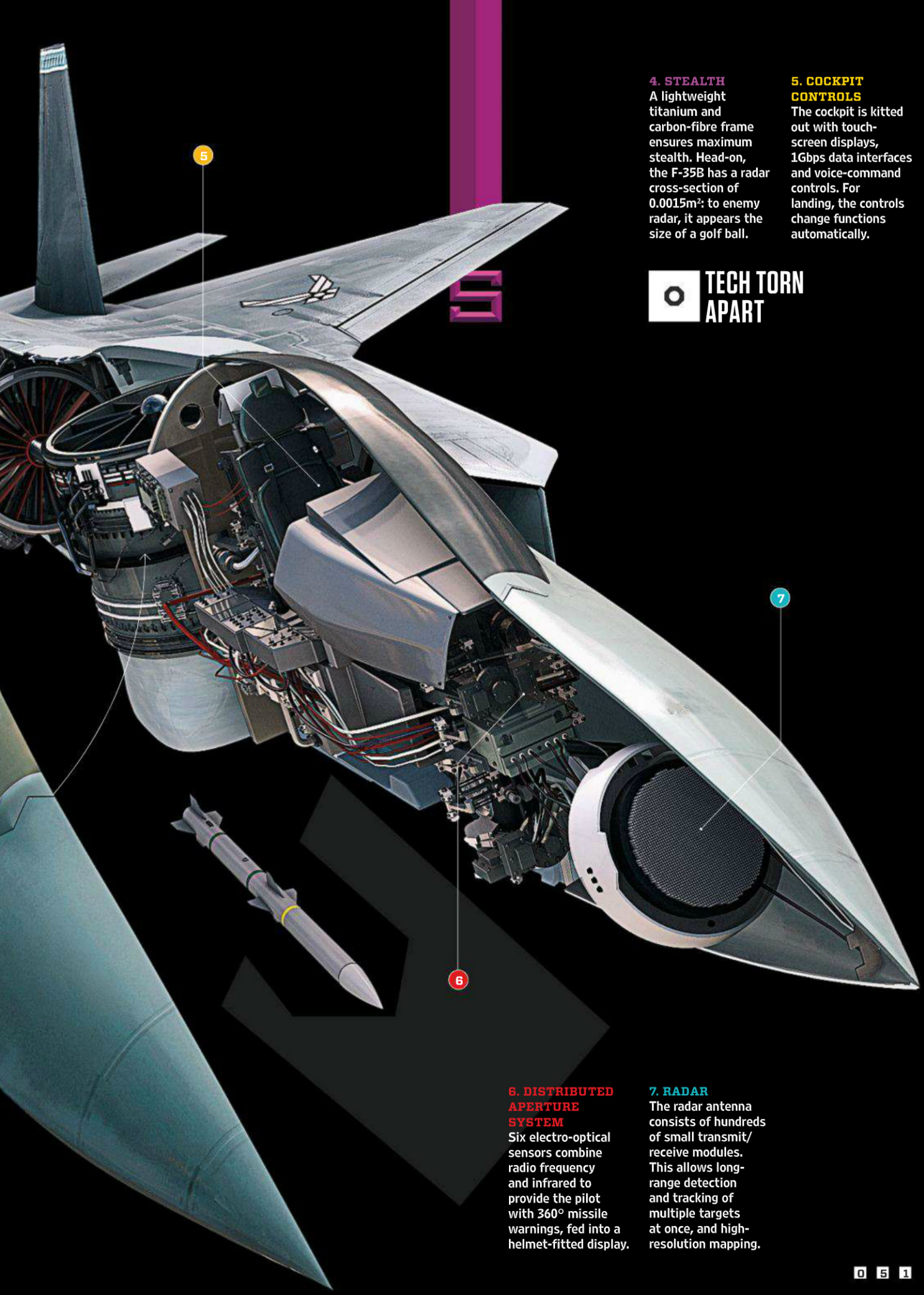
THE DOWNTURN IN DETAIL
The exhaust rotates in less than two seconds, generating up to 80kN of thrust. Roll-post thrust is constantly and automatically adjusted by cockpit computers.



1. EXHAUST NOZZLE
In flight, air is deflected through the exhaust nozzle horizontally. To aid vertical lift for take-offs and landings, the swivel duct rotates the nozzle near-vertically.

2. ROLL POSTS
With no forward momentum, the plane must be stabilised around its rolling axis in its vertical descent. The roll posts are supplied with engine fan air to provide a further 17kN of thrust.

3. LIFT-FAN
Door hatches at the top and bottom of the aircraft, just behind the pilot, open to expose the vertical lift-fan. Driven by the engine, the 1.3m-diameter fan is capable of generating 89kN of thrust.



4. STEALTH
A lightweight titanium and carbon-fibre frame ensures maximum stealth. Head-on, the F-35B has a radar cross-section of 0.0015m²: to enemy radar, it appears the size of a golf ball.

5. COCKPIT CONTROLS
The cockpit is kitted out with touch-screen displays, 1Gbps data interfaces and voice-command controls. For landing, the controls change functions automatically.

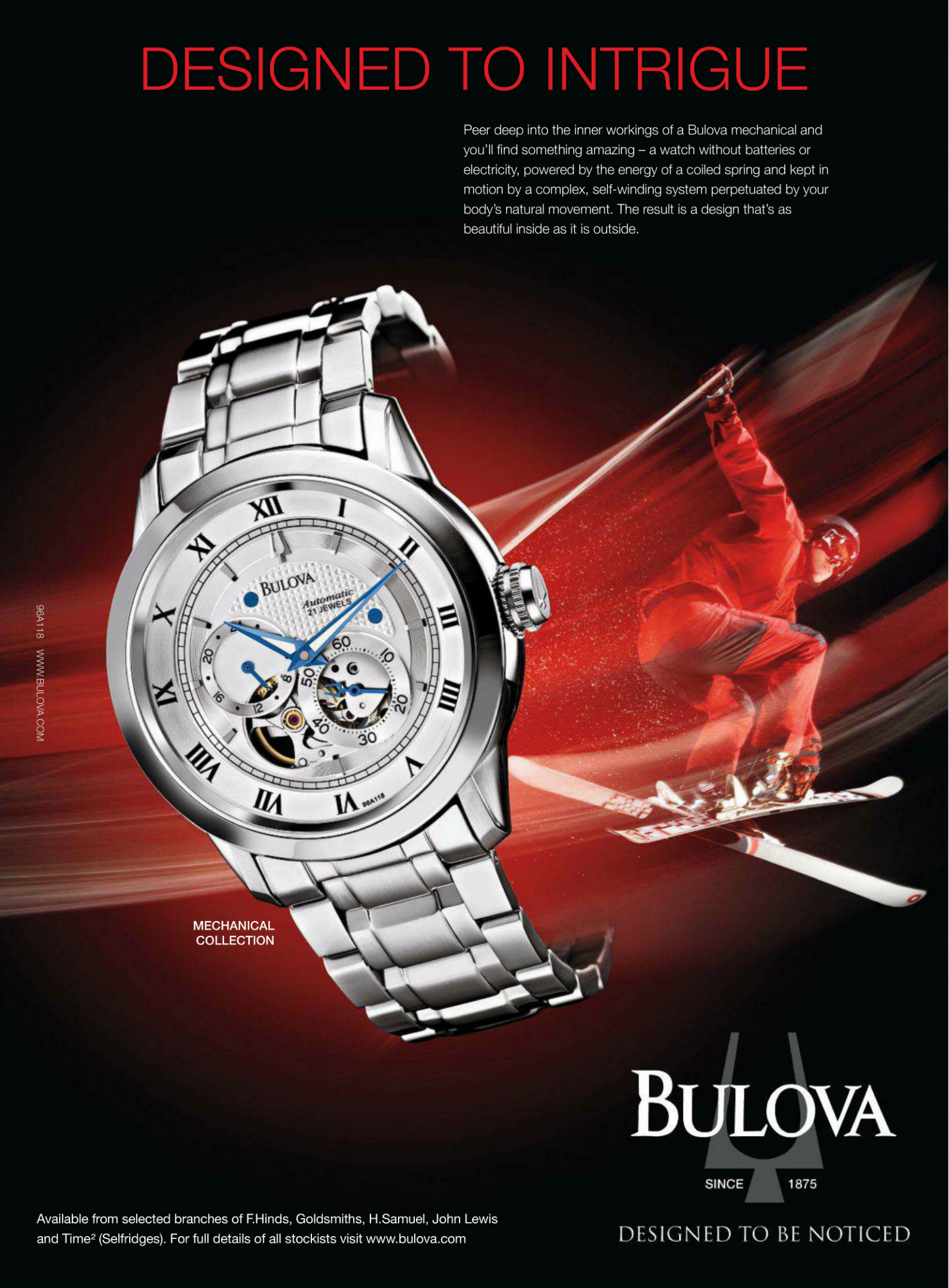
TECH TORN APART

6. DISTRIBUTED APERTURE SYSTEM
Six electro-optical sensors combine radio frequency and infrared to provide the pilot with 360° missile warnings, fed into a helmet-fitted display.

7. RADAR
The radar antenna consists of hundreds of small transmit/receive modules. This allows long-range detection and tracking of multiple targets at once, and high-resolution mapping.

DESIGNED TO INTRIGUE

Peer deep into the inner workings of a Bulova mechanical and you'll find something amazing – a watch without batteries or electricity, powered by the energy of a coiled spring and kept in motion by a complex, self-winding system perpetuated by your body's natural movement. The result is a design that's as beautiful inside as it is outside.



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DESIGNED TO BE NOTICED

Graphing your opinion

The cofounder of Jawbone wants to data-track points of view

Alex Asseily thinks the social graph is a little basic: "We want to elevate it to a more cerebral level – the opinion graph." The cofounder of Bluetooth headset manufacturer Jawbone is launching a new venture, State.it, which aims to connect people – not based on who they know but on what they think. "The idea is you get to state your opinion, in a simple way, but you get counted for it," he says. "So you can see what the world is thinking."

Internet forums 2.0, then? "Forums are unsexy. It's a global opinion network," says 36-year-old Asseily. "We're trying to create a metaphor for a town square where people can say what they think, but are also accountable for what they think. So it's not just, 'what do people think of the riots?', it's 'the people who thought the riots were awful, they also like Coke.'" State.it will tie users to a single identity as they weigh in across topics from David Beckham's new shoes to fiscal policy.

Name: ALEX ASSEILY
Occupation: FOUNDER, JAWBONE, STATE.IT
Location: LONDON
Need to know: HE'S HARNESSING PUBLIC OPINION AND FUSING IT WITH CAPTURED DATA

State.it has Tim Berners-Lee as an adviser, and will launch in 2012 from its base in Notting Hill, London.

This is a change of direction for Asseily. After civil war forced his family to flee Beirut for England, Asseily went on to study product design at Stanford. His senior thesis evolved into Jawbone, the consumer tech company he launched in 2006. It now has 200 employees and $162 million (£100 million) in backing. Jawbone makes hands-free headsets and the Jambox, a wireless speaker; in July it launched Up, a life-tracking wristband and app. So where does State.it fit in? It's the latest step in Asseily's "drive to improve communication". *state.it* **TC**

Top: Alex Asseily, surrounded by Jamboxes, and wearing an Up life-tracking wristband (*above*)

TWITTER-MINING
n. Extracting data patterns and useful information from Twitter posts. A recent study of over 500 million tweets showed that moods rise and fall in tandem throughout the world.

GAZANG
v. To pull out of buying a house at the last minute. Most "gazangers" get cold feet because they haven't found a new home that suits them or that they can actually afford.

ATROCIOLOGY
n. The study of violent deaths, particularly among prehistoric groups. Atrociologists typically examine grave site remains for signs of trauma and violent death.

DEJABI
n. A woman who finds the hijab makes her feel separated from society and defined solely by her faith. She can "dejab" and so wear more mainstream fashion.
Paul McFedries

PHOTOGRAPHY: ALEX LAKE. ILLUSTRATION: ROBIN BOYDEN

SUPER SHARP SHOOTER

Meet the small, light and superfast new Nikon 1 J1

Life moves faster every day. What you need is a camera that can keep up. Enter the Nikon 1 – one of the fastest, lightest, smallest camera systems in the world. Where others can be bulky and a chore to lug around, even with its interchangeable lenses the Nikon 1 J1 camera is compact and easy to use – with superb image quality. It is also available in five colours – hot pink, high-gloss white, matt black, silver and high-gloss red – all with accessories to match.

Four years in the making, rather than working from an existing template, the designers started from scratch. This ensured that the Nikon 1 can offer everything you need for speed, simplicity and enjoyment, shooting great photos and movies, as well as offering striking, minimalist design.

Its incredible speed is the gateway to a host of fantastic features. Powered by twin engines that can process images at an incredible 600 megapixels per second, it focuses incredibly fast, instantly detecting both shiny, moving objects and stationary, poorly lit ones, and shooting them with superior noise reduction.

Practically no movement is too fast to capture as the Nikon 1 delivers full-resolution images at up to 60 frames per second. And with Motion Snapshot, you can simultaneously record a slow-motion movie and a still image, capturing a "living image" of that whole moment forever.

You can also take a photo while filming, without interrupting recording, and film in extreme slow motion. The Nikon 1 even helps you get the best out of your shots – its Smart Photo Selector shoots 20 high-resolution images as you release the shutter, then saves the best five for you to choose from. All this and more is there to explore. *Go to* nikon.co.uk *to find out more.*

Multimedia comes to life thanks to the Short Movie Creator software, which automatically makes short films from your photos and movies with no loss of image quality

PHOTOGRAPHY: WILSON HENNESSY

Intuitive, clear menus, an easy-to-reach mode dial and a built-in flash means both you and the camera can think fast and act even faster

THE LENSES

10mm
The ultra-thin 1 NIKKOR 10mm (fixed focal length lens) is excellent for wide-angle shooting.

10-30mm
The 1 NIKKOR VR 10-30mm lens, with its standard 3x zoom, is a strong, flexible all-rounder.

30-100mm
Use the retractable 1 NIKKOR VR 30-110mm lens to get close to distant subjects.

10-100mm
Filmmakers will be more than happy with the 1 NIKKOR 10-100mm PD-ZOOM (power-drive zoom with adjustable speed) lens.

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EDITED BY JIM HILL

Want to take pictures? The focuser on the 250PX has an SLR camera connector

1 **MOBILE STARGAZING**
Sky-Watcher SkyLiner 250PX FlexTube

With its large 254mm mirror, this telescope is particularly adept at observing faint deep-sky objects such as nebulae. Sky-Watcher has made it easily portable by giving the classic 60s truss-tube design a collapsible frame, and the supplied 10mm and 25mm eyepieces provide x48 and x120 magnification. *£579 www.opticalvision.co.uk*

PHOTOGRAPHY: CHARLIE SURBEY. WORDS: JIM HILL

2 **EXTREME LUXURY GUITAR**

James Collins Swamp Ash Telecaster

Palladium is an excellent conductor, but rarely used in electrical instruments due to its high cost. That hasn't deterred musician and guitar-maker James Collins from using palladium wiring inside this swamp ash and maple axe for audiophiles. Unsurprisingly, he only made ten of them. *£1,850 jamescollinsguitars.com*

A metal plaque on the rear authenticates the model and gives a "date of birth"

The HT-D7100's Wi-Fi and downloadable apps enable you to stream from the web

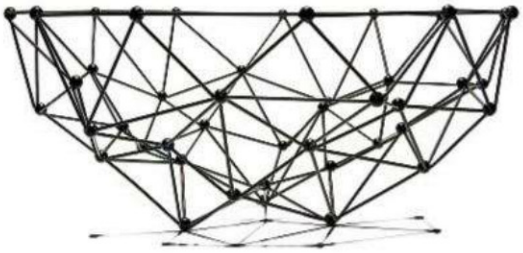
3	HOME CINEMA TRANSFORMER
	Samsung HT-D7100

The speakers, subwoofer, amp and Blu-ray player in this *Tetris*-like 2.1 home cinema system fit together into a single, bookshelf-friendly 180 x 180 x 270mm stack. You can also separate the components for maximum stereo performance. The deck plays 3D content and can scale up 2D to 3D, and standard-def to HD. *£400 samsung.com/uk*

PHOTOGRAPHY: CHARLIE SURBEY. WORDS: JIM HILL

1	STRIPPED-DOWN CYCLING
	Condor Lavoro

The design is simple, especially in this decal-free stealth build, but the Lavoro's frame is finely honed for racing. The superlight Dedacciai aluminium frame flares at the top of the down-tube for lateral stiffness and effective power transfer. Weighing in at just 1.5kg means there's little to stop the Lavoro – and you – flying on the track. *£1,300 condorcycles.com*



2 MOLECULAR DESIGN
BoConcept Molecules bowl

Physics inspired the design team at BoConcept to create this fruit bowl by binding molecules together, albeit on a much larger scale. As in your molecular chemistry class, this structure is made by joining spheres with metal wire to form a rigid shape. Luckily for you, the 22cm by 53cm bowl is ready-made, so you don't need to work at Cern to use it. *£119 boconcept.co.uk*

3 SELF-POWERED COFFEE
Presso Coffee Maker

The perfect espresso requires water at 90°C pushed through coffee grinds at ten-bar pressure: the Presso harnesses your own muscle power to create that force. Two aluminium lever arms squeeze up to two cups full of hot water through a chrome filter holder and valve into a steel cup. You'll need to heat the water yourself, of course. *£80.99 nigelsecostore.com*

MINIMAL SCIENCE

A LESS-IS-MORE TWIST TO YOUR DAILY APPARATUSES

4 NANOBALLS OF TIME
Ikepod HGS80 hourglass

Swiss watchmaker Ikepod has created an hourglass that approaches the accuracy of a mechanical chronograph. Instead of sand, gold-plated stainless-steel nanoballs slip through the funnel at an even rate. Designer Marc Newson used durable borosilicate glass in his elegant hand-blown design, which weighs in at a considerable 9.6kg. *£11,500 marcuswatches.co.uk*

5 PASSIVE SOUND AMPLIFIER
en&is MegaPhone

This tapering funnel is shaped to naturally amplify the sound from an iPod or iPhone. As with a gramophone horn, the sound waves extend and multiply as they pass from the tiny iPhone speaker through the widening passage until they produce sound loud enough to be heard across the WIRED office. The wooden cradle maximises the resonance. *£399 enandis.com*

PHOTOGRAPHY: SUN LEE, DAVE LIDW LL. WORDS: JIM HILL

1 ELECTROSTATIC SONICS
MartinLogan Montis

MartinLogan's electrostatic speakers use a micro-thin, curvilinear panel that vibrates with an electrical current to produce sound waves. This creates a detailed sound, but to deliver a deep bottom end the new Montis speakers rely on a 25cm drive unit. This hybrid design incorporates a Class D 200W amplifier to seamlessly integrate powerful bass. *£9,800 (per pair) martinlogan.com*

2 ROUND SOUND
SOEE Soundesign Drop

These unconventional French Drop speakers radiate sound on all sides to create a stereo soundstage without a singular sweet spot. The pointy diffuser on top guides sound from the upward-firing driver in a 360° formation to fill the room. The appealing teardrop-shaped wooden cabinets are available in a range of finishes. *€2,870 (standard finish) soeesoundesign.com*

GOOD VIBRATIONS

TREAT YOUR SOUNDWAVES TO SOME SUMPTUOUS SPEAKERS

3 MUSIC OF THE PODS
Scandyna Minipod II

The Minipod II's cabinet is an amalgamation of three spheres, each containing a drive unit or air port, to form one pressure-vessel. This gives the structure a rigidity that minimises cabinet vibration. The smooth plastic enclosure is available in a range of colours and you can also choose between leg stands and wall mounts. *£600 (per pair) scandyna-speakers.com*

4 BUTTERFLY EFFECT
OMA Monarch speaker

This wonderful creation incorporates two 38cm woofers and an oversized horn tweeter in a cabinet designed to reinforce and project their sound. The wooden butterfly wings serve as baffles that help the sound waves radiate forwards, which OMA says is the best way to deliver large-scale sound from low-powered valve amplifiers. *£60,000 (per pair) oswaldsmillaudio.com*

PHOTOGRAPHY: SUN LEE ROGER STILLMAN. WORDS: JIM HILL

The speaker, which weighs 74kg, produces a sound free of cabinet resonance

5 **HEAVY METAL**

ADN Acoustics Innova speakers

Traditionally, acoustic designers use ribs of wood to brace wooden speaker enclosures, preventing the propagation of square standing waves within. But after years of research, ADN has chosen to build its speaker cabinets from high-density molten aluminium – it claims the harder metallic surfaces are even more effective. *£16,000 (per pair) abc-audio.co.uk*

SPEAKERS' DINNER

A gathering of talent before WIRED2011

As you'd expect, when the speakers from WIRED2011 got together for dinner at Scott's in Mayfair, conversation was nothing if not stimulating. The night before the conference, we got some great insights from Richard Seymour, one of our favourite designers, on how the energetic and inspiring working relationship of Steve Jobs and Jony Ive redefined synergy.

Seymour also had a fascinating conversation with Stanley Yang, the visionary who is pioneering brain/computer interface technology for the mass market. Yang's inspiration came from his lifelong passion for *Star Wars* – it was in trying to create the Jedi "Force Trainer" for himself that he developed Mindflex, a ball game controlled by brain-operated headsets, which he would showcase on stage the following day at WIRED2011.

Meanwhile, social-gaming entrepreneur Kristian Segerstråle of Playfish told those at his table about the juxtaposition between growing up in rural Sweden and the seemingly urban pursuit of online games. The one, in fact, was a catalyst for the other.

Scott's in Mayfair was the venue for the speakers' dinner

The dinner's sponsor, Viadeo, couldn't have been more appropriate a host for the occasion, a very civilised bit of real world networking – though its own online network of over 40 million professionals slightly outnumbered the 20 WIRED2011 speakers. We'll just have to see if we can get a bigger guest list for next year's event...

1

2

3

4

5

Who's who at the Speakers' Dinner
1 Eyal Gever and Juliana Rotich **2** WIRED's David Rowan, with Richard Seymour and Stanley Yang **3** Gregg Delman and Carie Lemack
4 Ulla Engeström **5** The speakers enjoy drinks and a chance to mingle

PHOTOGRAPHY: MICK HUTSON

An eight-page conference report

You're not in England any more," David Rowan, editor of WIRED, announced on the first morning of our WIRED2011 conference. He was speaking metaphorically, of course – he wanted the 400 delegates to forgo English formality and start networking – but he may as well have been speaking geographically, or even temporally. For the next 48 hours, through 39 talks and presentations, the Renaissance St Pancras Hotel crossed into an unknown land: the future.

It's contested territory – strategist Rachel Botsman thinks it'll be a place of collaborative consumption; R/GA London planner and WIRED contributor Russell Davies talked of collaborative production. Facebook MD Joanna Shields was optimistic about technology catching up with human behaviour; author Andrew Keen argued that social media are making our lives narcissistic, and less private. Bill Bratton, former chief of police in Los Angeles, New York and Boston, saw value in this: he thinks Facebook will allow employers and the state to monitor potential troublemakers. "It's absolutely foolish what young people put on social networks," Bratton said. "It's going

WIRED 2011 Together with O2

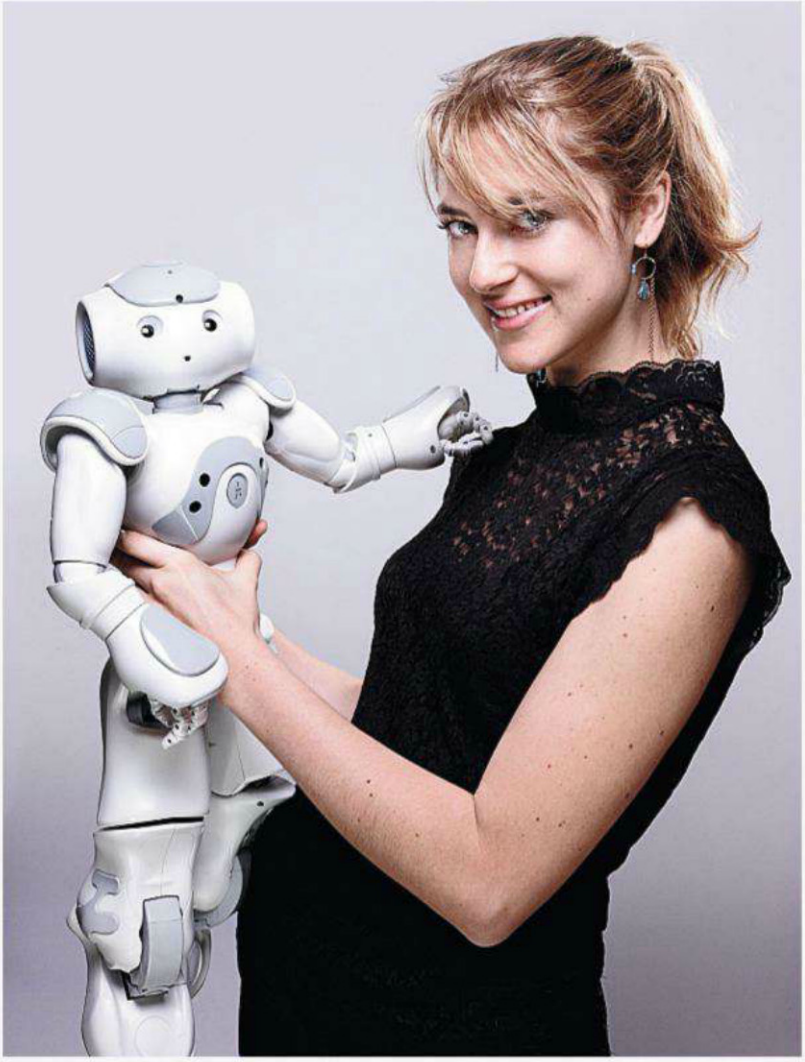
From the WIRED2011 stage: (*from left*) strategist Rachel Botsman, WIRED US editor-in-chief Chris Anderson and architect Bjarke Ingels

PHOTOGRAPHY: NICK WILSON

to harm them for the rest of their lives." Whatever happens, the future will surely involve increased adoption of artificial intelligence and natural user interfaces.

Stanley Yang, CEO of biosensor company NeuroSky, introduced a computer-brain interface headset that enabled him to compete onstage in a game in which he and delegates moved a ball using just concentration. Entrepreneur Gil Hirsch demonstrated face-recognition software that can be used for consumer applications, as well as surveillance. His new app, *Klik*, allows people to recognise friends on Facebook in real-time via their smartphone – photos are then tagged and uploaded to Facebook. Andrew Blake from Microsoft Research Cambridge talked about the history of computer vision and how games consoles are now able to "see" players; and roboticist Heather Knight demonstrated that humans and machines can share emotion as she interacted with Data, a robot that told jokes and danced better than many of the delegates during the evening's entertainment.

@christianhern: Two female scientists back to back at #WIRED11. Brains are sexy



PHOTOGRAPHY: NICK WILSON

HEATHER KNIGHT_
Enhancing robot-human interaction

Roboticist Heather Knight and her co-presenter Data (*above*) seemed to have veered off-script. "It appears," Data stated, "that art and science have absolutely nothing in common." "That's *not* what I said!" interrupted Knight. "What's artistic about modern physics?" Data shot back. "Let me tell you about the ancient Greeks," Knight replied. "Not again," Data groaned.

It's not a real argument. Data is, in fact, a white, 30cm-tall humanoid robot, co-built by Knight and programmed to take her to task like this. Knight is interested in how art and science can work together, and the dialogue she prepared is a clever example of how they can effectively do so.

But Knight is not just interested in this interplay for its own sake. A fan of *Futurama*, the TV show that depicts humans living side by side with machines, Knight wants to enhance social interactions between robots and people, and thinks the fusing of art and science is a good way of developing relevant ideas. "I think that if we design better social interfaces with technologies," she said, "we can more fulfil our capacity for being human." Such an approach has already helped her train Data to tell jokes and detect different levels of laughter from its audience.

Knight's research also led her to found the inaugural Robot Film Festival in New York in July 2011. The festival celebrates robot-themed films, awarding gongs to the best robot actors, as well as prizes for best screenplay and best film.

Who won the argument between Knight and Data? The ding-dong continued until Knight reminded Data of the golden ratio, the geometrical figuration renowned for its simple beauty. Data was finally convinced that science can be artistic and, as if overcome by the realisation, immediately broke into dance. The soundtrack? Michael Jackson's "Thriller".

JARGON WATCH

Geocities of things
As 3D printing and fractional artificial intelligence become truly mass market, the technologies will be mostly used to make ugly, fun things, as in the early days of the web – according to speaker Russell Davies.

Digital narcissism
Andrew Keen's thesis on social media: people tend to broadcast themselves, rather than listen to others. Ushahidi's Juliana Rotich responded: "If you are a rude narcissist offline, your digital representation will likely mirror that."

Launch to learn
Human needs may be constant, but the world is fast-changing and unpredictable, said Ideo's Tom Hulme. New companies should test market hypotheses by building and launching products, not business plans.

BREAKFAST IN THE FUTURE

The FutureScapes project, co-created by Sony and Forum for the Future, asked entrepreneurs and technologists 'How can consumer technologies help meet the critical challenges of 2025?'

On the opening morning of WIRED 2011, in The Gilbert Scott at the St Pancras Renaissance Hotel, a select group met before registration to examine the future. Drawn from the worlds of technology, design and business, the breakfast club had been invited by FutureScapes to discuss how consumer technologies may have evolved by 2025 in response to environmental and social pressures. Can products with sustainability baked in to their entire life-cycle reduce our impact on the environment, but still enrich our lives?

As coffee cups were drained and each table made its case, common themes emerged – such as how people, businesses and even buildings are creating and storing ever more information. The challenge is in harnessing this data – identifying energy and resource waste, so that carbon footprints, both individual and collective, can be reduced. New approaches and intelligent devices might include a smart power grid that monitors energy use, or app-enabled appliances which keep the fridge stocked, track our food kilometres and ensure good health. Robotics, artificial intelligence, gene sequencing and electric cars were all examined for their potential to make sustainability a seamless part of everyday life.

Now WIRED readers can join the conversation. What do you think life will be like in 2025? And what technologies will help us all live a better future?

+ CONNECTION
Oli Barrett
Cofounder
StartUp Britain

+ EFFICIENCY
Alex Laskey
Founder and President
Opower

+ EDUCATION
Emer Coleman
Director of Digital Projects
Greater London Authority

+ ENTREPRENEURS
Jamie Murray Wells
Founder
Glasses Direct

+ REVOLUTIONS
Ajaz Ahmed
Founder
AKQA

To watch videos of these five experts and have your say on the FutureScapes project, visit: ***wired.co.uk/promotions/futurescapes***

GEORGE DYSON_

Designing a new model of computing

At the start of George Dyson's talk, he showed a slide of what looked like a series of bright lights. This was a cathode-ray memory tube – one of 40 contained within a computer built by John von Neumann after the second world war. At the time the picture was taken, in February 1953, there was a total of 53 kilobytes of random-access memory (RAM) on the planet.

Many WIRED2011 speakers addressed the future directly. Dyson – science historian; author; builder of kayaks – found clues about that future by looking at the past; specifically, the careers of von Neumann and his English contemporary Alan Turing – who, Dyson argued, influenced von Neumann more than is acknowledged. Dyson introduced Turing's seismic 1936 paper, *On Computable Numbers*, which posited that anything can be computed, and which Dyson said von Neumann knew well. He discussed Turing's tape-based computer, showed how it shaped von Neumann's designs – before chronicling the latter's involvement in the hydrogen bomb.

At first, the pair's world seemed very far away. Their 53kb of RAM was smaller than many of today's emails. Later, Dyson showed a picture of a battered envelope, sent by von Neumann to his wife Klara. It once held four, hand-written pages of coding that would one day help build a nuclear bomb.

But gradually, Dyson connected their era with ours. We face, he argued, comparable conceptual problems to those that vexed Turing in 1936. Like Turing, who realised anything was computable, but didn't yet know how, "we are trying for a new model of computing that we can't yet understand". Although Turing went on to invent one-dimensional computing, and von Neumann its two-dimensional successor, we still don't understand what a 3D future looks like.

Dyson doesn't know either, but he suggested that a non-deterministic computing model – once advocated by Turing – might be a way forward. Most current coding is based on precise commands that tell the computer what to do with a piece of data at which time, and where. But what if we coded computers in less absolute terms? What if they could behave independently, make mistakes and learn from them? One system, Dyson pointed out, already works like this. It's called Google.

WATCH ONLINE_

To see video of the talks, go to wired.co.uk/11

RORY SUTHERLAND_

Using humour and human psychology

Rory Sutherland, vice-chairman at advertising agency Ogilvy, is clearly a man who does his own shopping. "Unexpected item in bagging area," he began citing the term heard at supermarket self-checkout machines. "Can you believe someone actually wrote that line?"

It's hard to think of a less human way of addressing the problem, Sutherland thinks. "It explains nothing, and actually just fills you with terror." The lesson to be learned from this trauma – and, indeed, from Sutherland's talk – is that we should try to make technological innovation as mindful of human psychology as possible. He showed that businesses can benefit if they combine technology with lessons from economics and psychology. Occasionally, his suggestions seemed knowingly glib. He said, only half seriously, that the wisest economists were those, like Ludwig von Mises, who were more concerned with human behaviour than mathematics, or who, like John James Cowperthwaite, ignored numbers altogether.

As the talk progressed, Sutherland showed an advertisement for IBM Lotus, in which the departure boards at Heathrow airport mashed departure information with news from Wimbledon. "Attention passengers on flight BA314 to Paris," read one screen. "We are pleased to announce Jo-Wilfried Tsonga [the French tennis player] is one set up." This, Sutherland implied, was a clever use of existing technology that advertised IBM's real-time capabilities in a funny, human way.

"Creativity is $9.99," he said, quoting *Mad Men*'s Don Draper, another reminder of the lessons from psychology that maximise perceived value. Take video

@GreatDismal: RT @haiyan So many talks here are quoting William Gibson it's a shame @GreatDismal isn't here #WIRED11 [Ears burning *off*!]

PHOTOGRAPHY: NICK WILSON

The Good Technology lunch at WIRED2011

GOOD FOOD, GOOD IDEAS

WIRED2011 wasn't just about the speeches: when entrepreneurs, thinkers, leaders and inventors from so many industries and countries meet, they want to talk, share ideas and network.

Good Technology were the perfect choice to provide a networking lunch – because they know networks. And they know that networked workers want to access their corporate systems, download files and get things done across a range of devices – whether in an office, at home or even having lunch at WIRED2011. For the modern employee convenience is key, and productivity a priority.

Increasingly, businesses are acknowledging this reality and moving to a "bring your own device" policy. If employees are going to work on their blazing-fast phone, why make them carry around an office-issued brick as well? In a survey of 1,000 UK workers, only eight per cent had an office-issued smartphone – 70 per cent used their own handsets.

When they do, they could be downloading and using unsecured or malicious applications, beyond the ability of their enterprise's IT department to keep them – and valuable data – safe.

Good Technology's solutions create a work-safe partition on mobile devices, which can be monitored, configured and controlled by IT staff – just like a work phone, tablet or laptop. Workers can get more done on familiar hardware – and their employers can cut out the needless expense of equipping and maintaining redundant devices. "Containerised" applications ensure that only secure, approved services get near to sensitive data. And, if the worst happens and the device is lost or stolen, the enterprise partition can be wiped remotely, or even set to self-destruct if it doesn't "check in" on time.

Businesses and governments are using Good Technology to give their workers office mobility, without office mobiles. To find out more, go to *good.com*

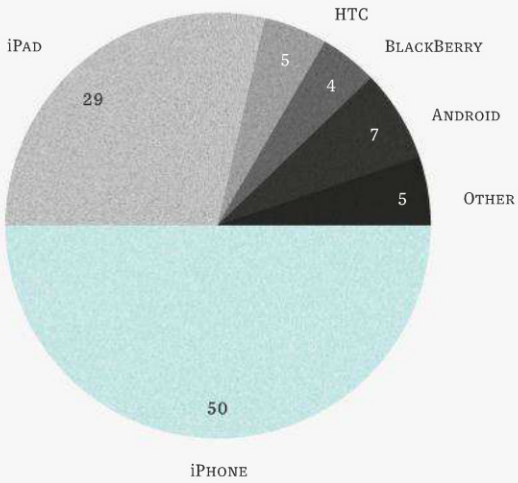
The lunch was attended by WIRED2011 delegates, press, and some of the influential WIRED 100

Good times
1/2 The BBC's technology correspondent Rory Cellan-Jones and Daniel Heaf, director of Digital BBC Worldwide, enjoy some Good company **3** Stanley Yang, CEO of NeuroSky, discusses the digital challenges of the future **4** Dimitri Volkmann, vice president of product management for Good Technology, talks challenges, solutions and launches

PHOTOGRAPHY: PETER GUENZEL

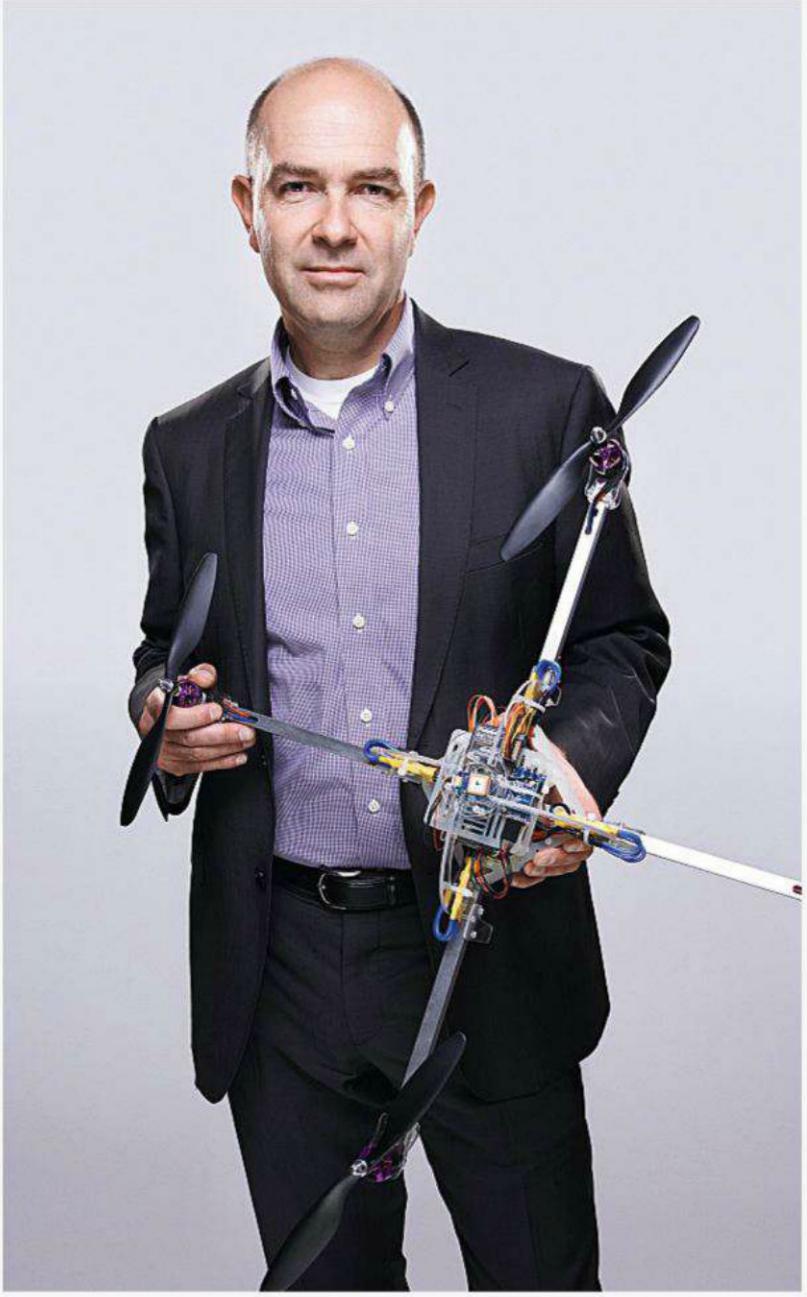
conferencing, for example, which would arguably have been a lot more popular if it had been marketed as "the rich man's phone", not "the poor man's flight". Likewise university tuition fees, which caused some students to trash Conservative HQ in November 2010, an image Sutherland flashed on screen. The government was foolish to reveal that university would cost £27,000. "They should have said, you'll pay absolutely nothing now, but if you earn over £40,000 by the age of 30, you'll pay an extra three per cent on income tax."

Devices in use at WIRED2011 *(%)*
DATA COURTESY OF O2



@vzain Vanessa Zainzinger
I have that post-Wired2011 feeling of inspiration and inadequacy. Beautiful

@StephenHill27
Love this idea of reputation capital, one to keep an eye out for



CHRIS ANDERSON_
The democratic industrial revolution

A violinist stood on stage playing "Preludio", from Bach's *Sonata No 3 in C Major.* It wasn't just a relaxing afternoon treat – the violin turned out to be central to the next speaker's argument.

Chris Anderson, editor-in-chief of WIRED US, believes we're on the verge of a new industrial revolution. One that will be altogether more democratic. It will give everyone – well, everyone with access to a computer – the chance not just to design, but to distribute. We might even get to make that violin, a copy of a Stradivarius, built by German company EOS using a 3D printer.

A picture of a young boy with his grandfather flashed on screen. This was Anderson as a child – in a lab with his grandfather Fred Hauser, the inventor of the automated sprinkler. Hauser made a lot of things, Anderson continued, but he never had the means to manufacture them, so he leased the patents to large companies. Today, Anderson noted, he wouldn't have that problem. If you've got an idea, you don't need a factory to build it. You can design it yourself using CAD, and then prototype it in a workshop using your 3D printer. And if you like what you've made, you can then mass-produce it in China through facilitators such as Shapeways.

This revolution will get individuals working together. Case in point: an unmanned drone, which minutes later buzzed above the stage. Anderson made it with the help of online collaborators and has set up a website – diydrones.com – to crowdsource design ideas for model planes.

PHOTOGRAPHY: NICK WILSON

A PERFECT MIX

WIRED and Courvoisier connect at the Upgrade Series

The mark of a good event isn't just the quality of the speeches, but the quality of the conversation. As the dust settles, guests want to corner speakers and pull the discussion apart, meet old friends and network with new ones.

WIRED crowds are certainly more communicative than most, which makes WIRED and Courvoisier ideal partners. WIRED's Upgrade Series with Courvoisier has gathered luminaries from worlds as diverse as architecture, entrepreneurship, music and robotics. Their challenge: to disrupt preconceptions and give insights into their fields – as they are now, and how they could be tomorrow.

Courvoisier, one of the world's oldest and best recognised cognac brands, has long been associated with pioneers and revolutionaries, from Napoleon Bonaparte to their own exclusive network, Courvoisier The Future 500.

The Upgrade Series aims to provide a platform for revolutionary thinking on how to upgrade our lives for the future. Join in and download an Upgrade insight report on "The City", "Going Out" and "Retail" at courvoisier.com. You might also want to try your hand at mixing the Courvoisier Punch that fuelled the before-and-after parties, with this recipe...

Courvoisier Punch
- One part Courvoisier VS
- Three parts lemonade
- 20 dashes of angostura bitters per litre of punch
- Three orange wheels and six lemon wheels per litre

EVENTS

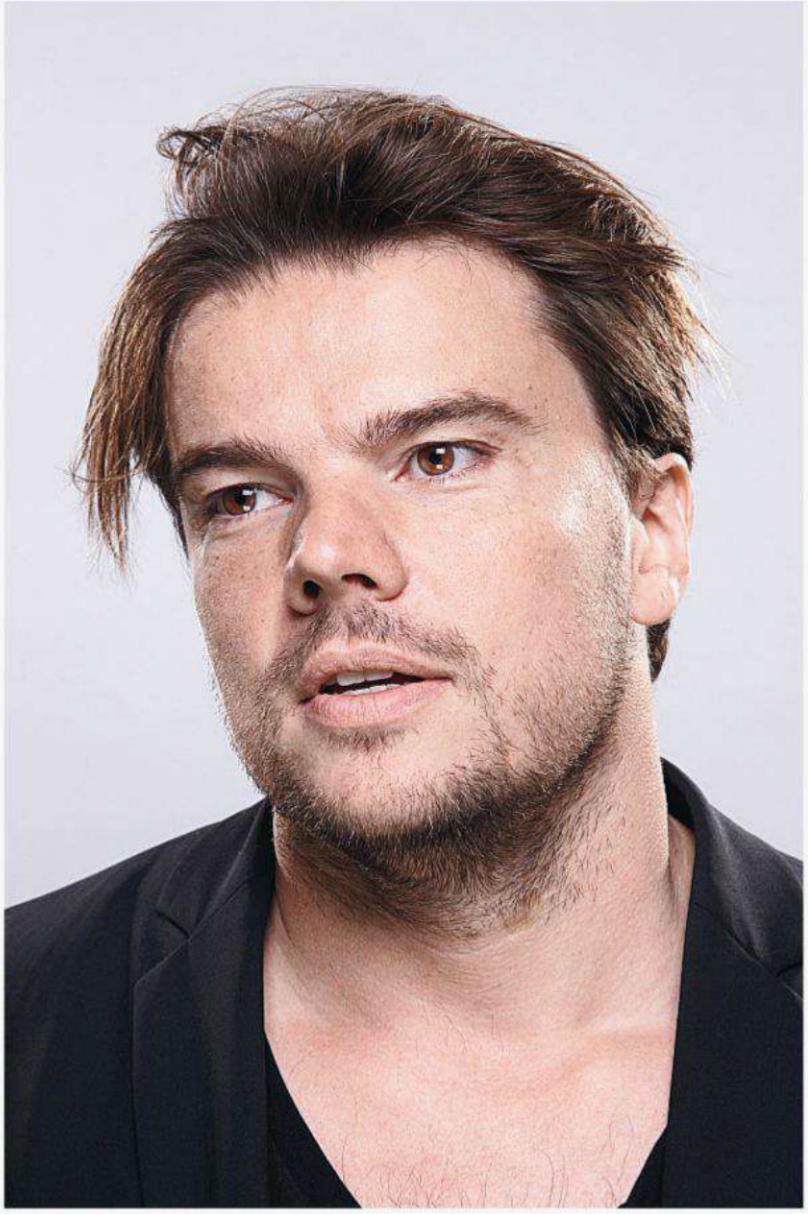
FAIL FAST
April 20, 2011
WIRED editor David Rowan hosted this panel discussion at the Courvoisier Future Gallery. Doctors can't afford to fail, noted Mind Candy CEO Michael Acton Smith – but web entrepreneurs can, and shouldn't be afraid to take risks.

THE FUTURE OF MUSIC
July 20, 2011
Guests at the Hospital Club had a chance to play with some outlandish instruments – including the Thingamogoop 2 and Kaossilator – before enjoying robot musicians, Imogen Heap's sound-manipulating "data gloves" and a lively discussion.

WIRED2011
October 13-14, 2011
The inaugural pan-European WIRED event brought an amazing agenda to the opulent surroundings of the St Pancras Renaissance Hotel – where else could you see Facebook's European MD and the Pirate Bay's former chief buccaneer on the same stage?

Which is how he met 21-year-old Jordi Muñoz, a self-taught electronics prodigy. Prototype by prototype, the unlikely pair came up with the parts for several designs. Now they've gone into business, manufacturing parts in China, and selling millions of dollars' worth every year.

Fred Hauser could make things, but he couldn't manufacture them. Today, Anderson concluded, "making is manufacturing".



PHOTOGRAPHY: NICK WILSON

BJARKE INGELS_
Electric cars with autopilot skills

Cars have become the bane of urban living, claimed architect Bjarke Ingels. Carbon-emitting, dangerous and noisy, they clog our streets and degrade the quality of life in cities. Ingels – who bounded about the stage, as restless a public speaker as he is a designer – believes we need to reconceptualise completely our ideas of urban space.

Ingels wondered whether we could make cars noiseless, driverless and pollution-free. Electric cars with autopilots could avoid obstacles by steering clear of GPS chips embedded in the pavement, and in pedestrians' shoes. This in turn would allow a car to predict its speed and direction and then highlight its route to pedestrians with a series of arrow-shaped lights implanted just beneath the road surface. If it worked, we might not even need roads in the traditional sense – just informal spaces.

Ingels's ideas are usually more practical, he said, but just as ambitious. His latest project, the renovation of a Copenhagen waste-to-energy plant, will feature a ski slope on top of the building – giving Danes, who live in a flat country, the chance to ski. The plant also reminds onlookers about the dangers of CO_2 emissions – a smoke ring 30m in diameter will be released whenever a tonne of CO_2 has been released.

Public participation is a recurrent theme in Ingels's work, as demonstrated by an image he showed of a town hall he is designing in Tallinn, Estonia. Ingels wanted to avoid creating a division between the hall and the public square outside – so he combined the two. He raised the hall, creating a public space beneath and within the building, immediately connecting the hall with the community it serves. He also placed the local council inside a glass-fronted room, which is visible to all passers-by, and hung an angled mirror over the councillors, so that, during council meetings, they could easily see the town and its citizens reflected, and be reminded of their responsibilities.

@The Sam Sheppard
I believe that for some people, #WIRED11 is going to be looked back on as a turning point in their lives

TREND SURFING

Near-immortality
Richard Seymour issued a prophesy that the first person destined to live to 1,000 has already been born. Sonia Contera spoke about how nanotechnology can repair human bodies, cell by cell.

Analogue computing
For 50 years we have been moving from analogue to digital; now we're going back, said George Dyson. Facebook is an analogue computer on a digital base, whose links cannot be tracked algorithmically.

Michael Jackson robots
The proof that artificial intelligence is here? Robots dancing to Michael Jackson. Heather Knight's Data robot performed to "Thriller"; Russell Davies programmed three Sony "Rolly" robots to do the same.

Bowers & Wilkins

Air your tunes

Zeppelin Air The ultimate AirPlay® wireless audio system is a true 21st century hi-fi. Apple's AirPlay technology allows music to be streamed wirelessly from your Mac or PC to Zeppelin Air for pristine, room-filling sound. You can even bypass the computer entirely, and stream high-quality audio directly from your iPhone®, iPad® or iPod® touch. All without the need to dock the device.

www.bowers-wilkins.co.uk

Zeppelin Air is available from John Lewis, Apple and selected retailers.

iPod, iPhone and AirPlay are a trademarks of Apple Inc., registered in the U.S. and other countries.

THE SPEAKERS_

Who was on stage at WIRED2011

BJARKE INGELS
Architect; founder, BIG
Hedonistic sustainability meets extreme public participation

ULLA ENGESTRÖM
Founder and CEO, ThingLink
Everything is a platform

CHRIS ANDERSON
Editor-in-chief, WIRED US
Atoms are the new bits

RUSSELL DAVIES
Head of planning, R/GA
What happens when we put data in things

JULIANA ROTICH
Cofounder and executive director, Ushahidi
Crowdsource your crisis

ALEXANDER LJUNG
Founder and CEO, SoundCloud
Play: Creative business

SONIA CONTERA
Codirector, Institute of Nanoscience, Oxford University
The future of medicine

EYAL GEVER
Artist, entrepreneur
Sublime moments

HEATHER KNIGHT AND DATA
Robot expert; student
Devilishly charming robots and charismatic machines

STANLEY YANG
CEO, NeuroSky
The future of bio-interfacing for consumers

LISA HAROUNI
Cofounder and CEO, Digital Forming
A revolution in mass customisation

WERNER VOGELS
VP and CTO, Amazon
Data without limits

MATTHEW KEY
Chairman and CEO, Telefónica Digital
How mobile will change the world

JOANNA SHIELDS
Vice-president, Facebook EMEA
Giving people the power to share

STUART JACKSON
Regional manager, Electro Optical Systems
A revolution in mass customisation

TOM HULME
Design director, IDEO
Launch to learn

GEORGE DYSON
Technology historian
The birth of the digital age

NOREENA HERTZ
Economist
Predicting the future

ANDREW KEEN
Entrepreneur, speaker and writer
Digital vertigo

TIM EXILE
Musician
Play: Creative business

AZA RASKIN
Entrepreneur and designer
A design renaissance in medicine

RORY SUTHERLAND
Vice-chairman, Ogilvy Group UK
Where tech, psychology and economics meet

LUKE JOHNSON
Chairman, Risk Capital Partners
The agony & ecstasy of being an entrepreneur

RACHEL BOTSMAN
Social innovator, author, speaker
Collaborative consumption

CORY ARCANGEL
Artist
Play: Creative business

CHRISTOPHER MIKKELSEN
Cofounder, Refugees United
Lost and found: Connecting families

GIL HIRSCH
Cofounder and CEO, face.com
Is that you?

SHILO SHIV SULEMAN
Artist and storyteller
Indian innovators

HANS ULRICH OBRIST
Codirector, the Serpentine Gallery
Play: Creative business

JOSEPH VARDI
Entrepreneur and investor
The true wisdom of the crowd

ANDREW BLAKE
MD, Microsoft Research Cambridge
Computer vision comes of age

ALEX LASKEY
Founder and President, OPOWER
The future of home energy management

BEN HAMMERSLEY
Editor-at-large, WIRED
When first they punch the ballet dancer

GEOFF MCGRATH
MD, McLaren Applied Technologies
Racing on real-time data

LAKSHMI PRATURY
Host and curator, The Ink Conference
Indian innovators

PETER SUNDE KOLMISOPPI
Founder, Flattr; The Pirate Bay
Disruption alert

WILLIAM BRATTON
Vice-chairman, Homeland Security Council
Data-driven policing

DEBORAH BEREBICHEZ
Science communicator
The physics of time reversal

RICHARD SEYMOUR
Cofounder, Seymourpowell
Immortal design

SHANTANU MOITRA
Composer
Indian innovators

HENRY ROBINSON
Human-rights activist, and
CARIE LEMACK Cofounder, Global Survivors Network
How the Formers change minds

PHOTOGRAPHY: NICK WILSON

RICHARD SEYMOUR_

Using the past to be progressive

"What is this?" asked Richard Seymour, halfway through his presentation, pointing at an onscreen photo. "It's not a trick question. It's a typewriter." But an eight-year-old shown it had a quite different response: "It's a computer that prints while you type, and you don't have to plug in."

The audience laughed, but designer Seymour was making a serious point: a typewriter is only a typewriter because we perceive it as one. Yet what might initially seem a dated, analogue device could be the template for something progressive and digital. "Technology doesn't hold us back," Seymour explained. "What does is our lack of imagination."

So, he argued, by radically rethinking existing technology, we can reimagine the future. He cited airship technology that has been around since the early 20th century but, with vision, could be used for contemporary recreational travel. He showed a diamond-shaped airship that has been conceived by his firm Seymourpowell (and featured on wired.co.uk). Seymour believes the hydrogen-powered craft could combine the comfort of a luxury hotel with the excitement of a long-distance air safari as it drifts over multiple tourist destinations. "You won't go to your holiday in it," he explained. "You'll have your holiday in it. It's competing with Barbados, not British Airways." We're not necessarily living through a digital revolution, he later concluded. It's a "digitally facilitated" analogue revolution.

A few slides later, Seymour held up what looked like a translucent credit card and asked the audience to identify it. The card didn't contain money. It contained the genetic code of a human being. Seymour believes that genetic sequencing will be the innovation that has the greatest effect on designers in the near future. He flicked to a picture of a red pill: thanks to developments in gene research, those who consume it daily can minimise their wrinkles. Similar research might soon add decades to the lengths of our lives, Seymour claimed, and in some cases centuries. "The first person to live for a thousand years," Seymour said, "is possibly already alive."

"For those interested," David Rowan said as Seymour left the stage, "WIRED is now offering 1,000-year subscriptions." W

NEXT YEAR_
To register for WIRED2012, go to wiredevent.co.uk/how-to-book

THE WIRED2011 INDEX_

128

Number of Macintosh 128k computers needed to match the processing power of one iPhone, according to Tom Hulme

43 MILLION

Number of refugees worldwide, according to Chris Mikkelsen of Refugees United, which aims to reunite families separated by conflict

43

Number of speakers on stage at WIRED2011

1.5 BILLION

Data points collected from an F1 vehicle during a race, according to Geoff McGrath

20

Number of nationalities of delegates at WIRED2011

83%

Proportion of UK population predicted to be obese by 2020, according to Aza Raskin

130

Age at which many of the twentysomethings in the audience may die, according to Richard Seymour's presentation

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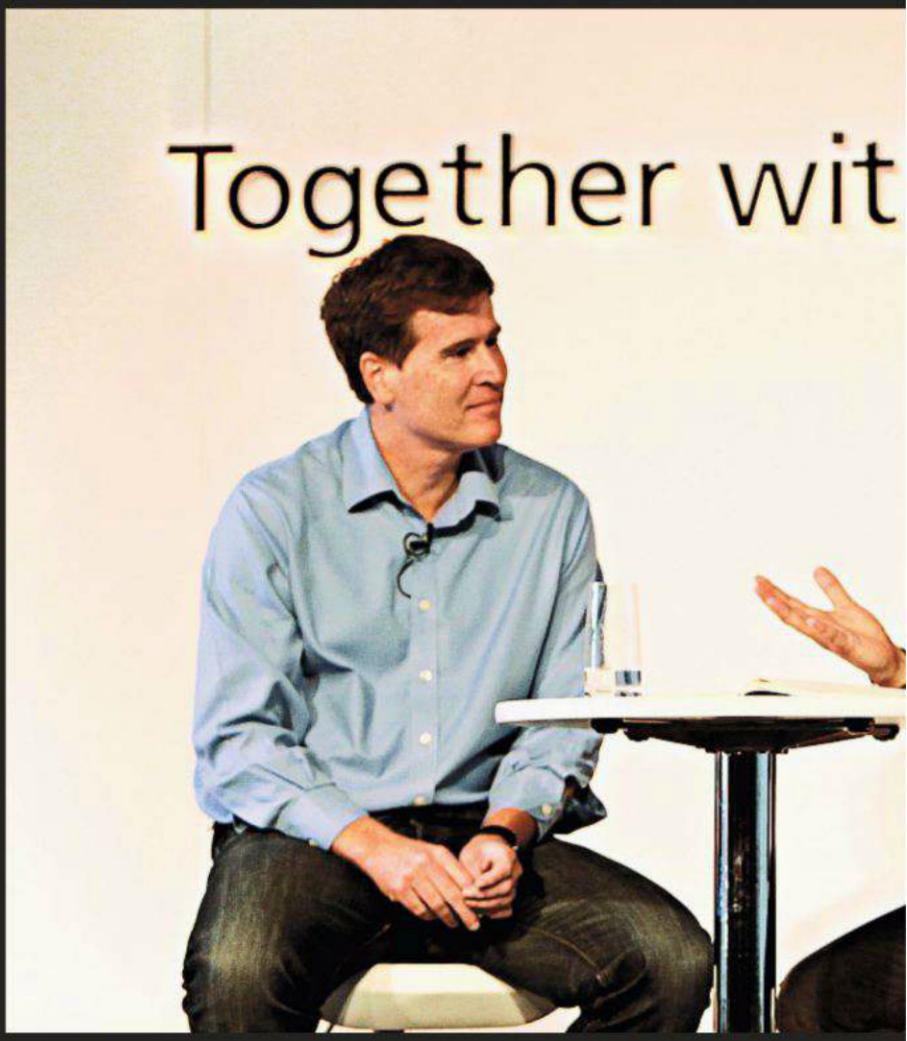
WIRED TOGETHER

O2 came to WIRED2011 to discuss Telefónica Digital's plans for the future



As the anchor sponsor of a new event – especially one called WIRED2011, Together With O2 – you might expect a fairly gentle on-stage interview. At least, you might – until you discover that your interrogator will be Ben Hammersley (*far right*), WIRED's maverick editor-at-large. Joining him at WIRED2011 was Matthew Key (*near right*), recently appointed CEO of Telefónica Digital, who answered some pretty tough questions.

The big issue, of course, was Telefónica Digital. Key took charge of the newly-created division in September, moving from a role as chairman and CEO of Telefónica Europe. It was, he explained, where he needed to be, and where O2, Telefónica's commercial brand (in northern Europe), needed to be. His job is to lead by example, inspiring the transformation of Telefónica from a traditional telecoms player to a digital innovator.

The future, according to Key, is So:Lo:Mo – social media, local search and mobile enablement. A business that stuck to providing only voice and data connectivity, and left the rest to third-party developers and mobile software giants, would get left behind.

O2 demonstrated some of their current and planned innovations over the two days of WIRED2011. Leading the way was Priority Moments – a service that matches a handset's position to nearby special offers.

"So, tell me," Hammersley challenged, "How is that not like Groupon?"

"Ours is entirely location-based," Key responded. "So you don't get offers for stuff

O2 Connect
Allows customers to use wireless networks – such as O2's event hotspot – to make free calls.

O2 Wallet
Enables cashless, contactless payment from O2 phones with near-field communication capability.

Priority Moments
An app identifies special offers and promotions a stone's throw from the phone.

that's on the other side of the city – and they are for things you're actually interested in."

O2, he explained, had an advantage in the app space: it already has a huge user base, intimate knowledge of the phones they use and relationships with a range of brands. That gave the company the opportunity to develop services such as 1st Edition, where customers can preview and feed back on products before launch.

Matthew Key knows that customers want new services, and that someone – whether O2, Google or a bedroom coder – is going to create and offer them. His challenge is to bring the values and agility of a startup to Telefónica's international operations and its hundreds of thousands of employees. Telefónica Digital – soon to relocate to London from Slough, so as to be more attractive to the city's best technologists – is taking the lead. Watch this space.

LIVE WIRED

O2 and WIRED threw a lively party, complete with cocktails, comedy and conjuring

Anyone checking their Priority Moments near the St Pancras Renaissance Hotel on Thursday, October 13 would have seen Live WIRED, the evening's entertainment laid on by O2 for the WIRED crowd. After a day crammed with inspiration and education, the event crowd was ready to let its hair down and have some fun – and Live WIRED certainly delivered.

Throughout the evening, Alexander Armstrong compered and the street-smart magician Damien O'Brien worked the crowd with some close-quarters trickery. But the musical acts really brought the noise. First up, Abandoman, Ireland's self-proclaimed seventh-biggest hip hop crew (two ahead of Jedward), dropped a long-form improvised rap based on the contents of the audience's pockets. But the real show-stopper – and show-closer – was Shlomo, the astrophysicist-turned-champion-beatboxer. With no instruments but fiercely flexible faces, he and his band Lip Factory spun, scratched, broke down and took the audience on a musical journey through the history of pop.

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Will Cooper-Mitchell, Lumix G3, 25mm, 1/320th sec, @ f 10, ISO 200.

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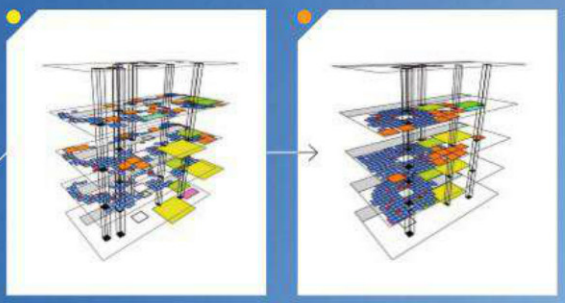
- THE ART OF GAMING
- PARAHAWKING TAKES OFF
- OPEN-SOURCE *SSX*

EDITED BY CHARLIE BURTON



Rooms on the floorplan jockey for space in one configuration...

...make an adjustment, say, moving a pillar, and they shuffle into place

OFFICE DESIGN BY *TETRIS*

When designing a building, creating room layouts is a time-sap. Middle managers' offices need to be close to their admin staff; executive suites need to be within striking distance of their subordinates. Move one room, and you have to rearrange them all. Aedas (the global architecture firm that designed New York's National September 11 Memorial and Museum) may have a solution.

The layout problem arose when Aedas pitched for the contract to build the Abu Dhabi Education Council (ADEC) headquarters in UAE. So its London-based R&D group, led by Christian Derix, created a piece of software that took ADEC's gargantuan list of required rooms and fed it through an algorithm based on a simple model called attract/repel.

"The rooms try to move next or nearby to those which they are meant to be located. They're attracted to each other," says Derix. "Rooms not meant to be near one another are 'repelled'." Change one of the parameters in the model – move a lift shaft, say – and the pieces ping about until they settle into a practical arrangement.

Previously architects were forced to make endless redrawings if they wanted to consider different options; Aedas can instantly adjust the floorplan. The architects found they could bring the rooms together so tightly, in fact, that they created space for large voids to ventilate the building naturally, as well as making it more spacious. The cubist style of the building's façade (*see model below*), suggesting the rooms within, was the architects' way of honouring their algorithm. Work begins in January. **Tim Abrahams** *aedas.com*

NOOMI RAPACE GOES CULT

When Noomi Rapace played hacker Lisbeth Salander in the Swedish/Danish film version of *The Girl with the Dragon Tattoo*, she wanted to surpass the stereotype. "During the research, I spent time with this hacker in Sweden – a friend of a friend of a friend. And I promised never to talk about him at all. I don't even know his name," says the Swedish actress. "For him, breaking into computers had a perfect clarity – it was almost as though he could see in colours, read the logic in the whole system. I was also talking to banks and finance people – they're always behind. Hackers are like anarchists: if they're crazy enough, they'll always win."

Now Rapace is swapping Scandinavian conspiracies for Victorian adventures in *Sherlock Holmes: A Game of Shadows*, her Hollywood debut. "It's my first movie with green screens and thousands of extras," says the 32-year-old. "You need to imagine more, but it's the same work."

Next up is *Prometheus*, Ridley Scott's 3D prequel to the iconic *Alien* franchise. The director has described the film as "really nasty" and Rapace says the filming process was stripped down. "Contractually I can't say much about the aliens. But it was really physical. I think we used a green screen only twice. It felt like I was out on a real planet fighting real things. I was not pretending that much."

Rapace plays Elizabeth Shaw, a British-born scientist stuck in outer space. "I was 13 when I saw *Alien*, and I became obsessed," she says. "I adore Ripley – she's so modern." So, would she be happy to replace Sigourney Weaver in the hearts of sci-fi fans? "Yeah! Absolutely." TC

Downey Jr, Rapace and Law go up against Moriarty in the latest *Sherlock Holmes* film

High-score art

Duncan Harris uncovers the frozen beauty behind the frantic pace of the latest games

To Duncan Harris, games are misunderstood. "The first thing people see is the technology, and that distracts from the art," explains Harris. The Chippenham-based "game tourist" created Dead End Thrills, an online gallery of images that Harris made from video games. "What I do is almost like restoring a painting – stripping away the layers of technology to get to the artist's original intention."

Now 33, Harris started reviewing games in the days of the PlayStation 2. Sitting for hours capturing screenshots, he started to see the backgrounds, the idle

PHOTOGRAPHY: CORBIS OUTLINE

animations – details that get missed in the heat of battle. "I would spend ages steering myself into corners so the camera view wouldn't be blocked by my game character."

To create high-quality still images, Harris uses debugging tools as well as software wrappers that crank up the detail to 2,160p – twice as sharp as an HD monitor. "Setting up the shot" involves finding the perfect angle and image to evoke the spirit of the game. Perhaps one in 200 shots meets his standards; the rest are deleted.

The games industry is now using Dead End Thrills for reference as to how its own assets can look. So, do you need a supercomputer to generate such detailed images? "It's surprising how much you can do with a regular high-end PC," says Harris. "But I am a little cavalier with graphics cards – there's a lot of heat. I wouldn't recommend trying it at home." **Daniel Nye Griffiths** *deadendthrills.com*

- Remove the HUD, health bars, crosshairs and guns poking into the scene.
- Lower the field of view – wide-angle views often create a fish-eye effect.
- Line up and frame the shot using a free camera or height adjustment.
- Freeze the frame – some games can be stopped, others only slowed down.

Below: this still from id Software's *Rage* was created with programmers' debugging tools

The sleek DS3880W features a conductive charging battery that lasts for three hours. The DS3800W shares the same good looks, but is mains-powered

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Artistic twist

Sculptor Evan Penny creates huge silicone people straight out of uncanny valley

It's the scale of the oversize visages that makes you stop. But it's their distortion that makes you stare – then look away. That's what Evan Penny wants: the Toronto-based artist (*bottom right*) makes deliberately disturbing silicone faces and bodies. "Humans are sensitive to distortions in their bodies – seeing them manifested can be a threatening experience," he says. "The brain has to work overtime."

Penny scans his subject with a 3D-imaging rig, then imports the data on to his computer, where he skews the image – but stretch the human form too much and it's unrecognisable. The trick is to find the unsettling sweet spot where the brain recognises features but can't make full sense of them. "Perceptually, it has to be believable," he explains. The model data is sent to a computer-controlled milling machine, which produces a hard foam core. Penny then applies a layer of clay and sculpts it into a form that will be moulded and cast in silicone. His work is displayed at the Museum der Moderne in Salzburg until February 19. **Christopher Jobson** *evanpenny.com*

Shelley (2008): 64 x 61 x 18cm; silicone, hair, pigment and aluminium

Aerial #2 (2006): 269 x 152 x 33cm; silicone, hair, pigment and aluminium

ARTWORKS: ARIEL #2 COURTESY OF PRIVATE COLLECTION; SHELLEY COURTESY OF SPERONE WESTWATER, NEW YORK

Digital magician

Marco Tempest makes open-source magic for the 21st century

Magic tricks depend on secrecy. So it might seem counterintuitive that Marco Tempest – a Swiss-born magician living in New York – has gone open-source. He reveals his methods, talks to his audiences online and asks for feedback. "If someone has a good idea, I put it in my show and give credit," says Tempest, 46.

His illusions embrace screens, augmented reality, robotics and software (which he makes available to download for free), and familiar magic props. In his "magic projection" trick (*pictured*), balls appear to move between the real and virtual worlds.

He describes his act as "sustained magic". Rather than a moment of revelation, in which, say, the correct card is called, there is a continuously magical experience. "It's not what you'd expect from a magician, but it works. For [an illusion involving three iPhones] I removed all the 'big magic' such as the iPhones disappearing at the end, because you just end up going, 'How did he do that one?', instead of, 'Oh I've never thought that deception could be something good.'" Still, traditional magic is woven into his shows – only unannounced. "When the audience isn't really sure – 'was that a shuffling thing or the computer?' – then it's working."

Tempest used to be a conventional magician. But he decided that, in the web era, this would be a dangerous career decision. "The audience will figure out your tricks on the internet," he says. "If the only thing you're offering is, 'How did I do that?', it's over. Magic is about having a relationship with your audience. So this approach is perfect." **CB** *marcotempest.com*

Marco Tempest won the World Technology Award 2011 for The Arts in October

PHOTOGRAPHY: MILLER MOBLEY
ILLUSTRATION: KELLI ANDERSON, SCOTTY REIFSNYDER

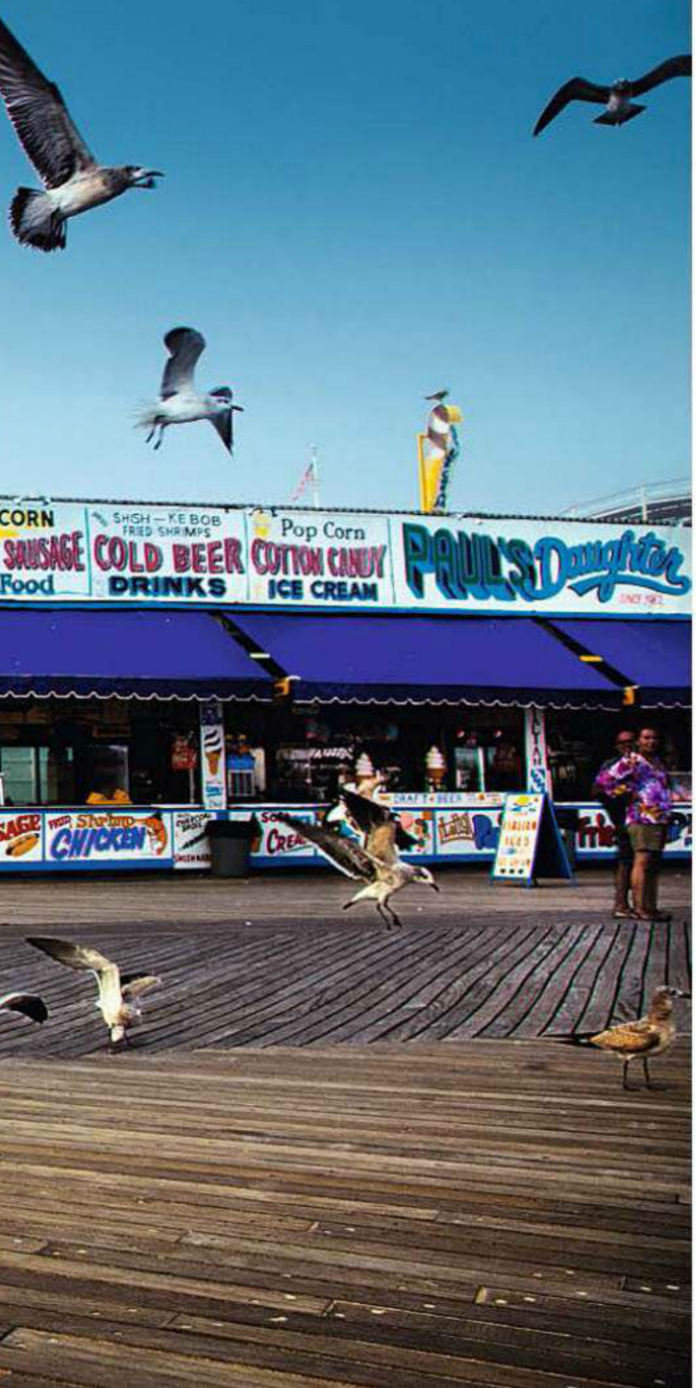
TEMPEST'S TOP TECH TRICKS

THREE-iPHONE ROUTINE
Using sleight of hand and video across three iPhones, Tempest tells a story of deception. *tinyurl.com/3m6eut5*

MAGIC SLATE
Projection mapping and position detection let Tempest draw figures that come to life. *tinyurl.com/2bykl2f*

CARDS REVEALED
As Tempest performs a card trick, AR annotations show the viewer what he really sees. *tinyurl.com/64p3tfd*

PHONECAM MAGIC
Tempest takes to the streets and performs illusions filmed with his phone's camera. *tinyurl.com/63rcvd3*



HEIDI KLUM: MALWARE QUEEN

Sure, a fixation with supermodels could compromise your relationship – but spare a thought for your computer's wellbeing. Criminals use famous names to attract unsuspecting users to sites laced with malware. Cyber-security company McAfee has mined its data for an A-list of celebrities that you don't want to Google. No, really. CB

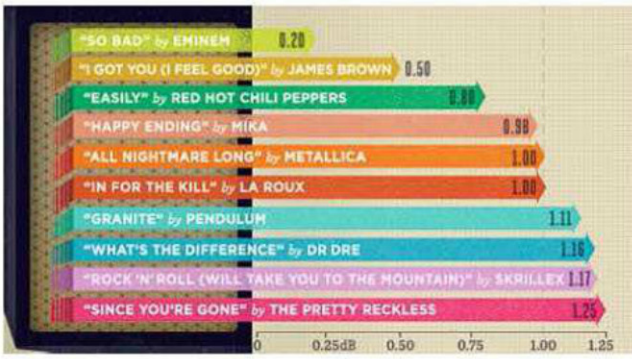
In order, with last year's position (in brackets) and chance of landing on a malicious site (%)

1 (=10) **Heidi Klum** – 9.17%
2 (1) **Cameron Diaz** – 9.08%
3 (-) **Piers Morgan** – 8.92%
4 (3) **Jessica Biel** – 8.83%
5 (-) **Katherine Heigl** – 8.67%
6 (-) **Mila Kunis** – 8.17%
7 (=10) **Anna Paquin** – 8.08%
8 (6) **Adriana Lima** – 8.00%
9 (-) **Scarlett Johansson** – 7.83%
10 (-) **Emma Stone** – 7.67%

And the least risky: Prince Albert of Monaco (0.92%)

MUSIC: TURN IT UP!

You're not hearing things: music is getting louder as recording engineers pump up the volume to make their tracks stand out. Paul Lamere of music-tech blog musicmachinery.com analysed data from Echo Nest, a music-intelligence company, to find out who's on 11*. CB



*LIST DRAWN FROM TRACKS THAT SHARE A HIGH POPULARITY RATING

DIGITAL ETCHINGS

The flatbed scanner is old school. Enter the Inkling, created by Japanese company Wacom. It's a ballpoint pen that can draw on paper, but also creates a downloadable digital image. A small device clipped to the top of your pad traces the pen's movements using infrared and ultrasound. Tom Gauld, who used it to draw the third panel of his strip (*above*), shares his opinions; Wacom's global product manager Glenn Tsunekawa responds. CB

ARTIST VS MANUFACTURER

TOM GAULD: I don't see why you wouldn't just draw in pen and then scan it into a computer.
GLENN TSUNEKAWA: Say you're out in the park and you have your notebook and PC but no scanner, you can sketch as you normally would and right there put it into Photoshop.
TG: The box didn't pick up every movement to the quality that I'd expect. There are bits in my finished illustration where the crosshatching isn't within the lines.
GT: Under normal working conditions we want the product to be accurate to within plus or minus 2.5mm. This product is best for rough sketching and brainstorming – if you're looking for a solution that you can take straight to print or CAD, you probably wouldn't have a satisfactory experience. But it does get your data into digital right away – and you can edit the lines easily.
TG: I found trying to draw while keeping my fingers out of the beam was quite uncomfortable.
GT: It's one of the technological limitations of this product: the communication between the receiver and pen is paramount. The only way around that would be to have a wired product, and we wanted it to be wireless.

- The Inkling is both a regular pen and a digital transcription device
- Upload your sketches to your computer via the supplied USB cable
- The sensor clips to the top of your pad and tracks the pen
- Coloured cartridges and nibs for use on old-fashioned paper

Movies go analogue

Super 8 filmmaking is back – try these contest-winning tricks from the film pros

Sorry, digital – a new wave of filmmakers is embracing the analogue charms of Super 8 film. The cameras can be tricky to come by – your best bet is buying a vintage used model from eBay – but Kodak still makes four types of Super 8mm film stock, and UK Super 8 competitions are increasingly popular. One such contest is Straight 8: entrants shoot an unedited short on a three-minute Super 8 cartridge, and they don't get to see their finished film until it screens at one of the Straight 8 events. The highlight of this year is a Cannes Film Festival screening.

We asked four prize-winning Super 8 directors, including George Ancock (*left*) and Will Cummock (*right*), to reveal their cinematic techniques. **CB** *straight8.net*

THE WIRED FILM SCHOOL

AUTEURS: GEORGE ANCOCK, WILL CUMMOCK (*SEE MAIN IMAGE*) AND NICK RUTTER, UK
Reel to watch: *From Russia With Monsters* (tinyurl.com/64q8qkl) and its clever "digital" effects.
Trick to try: Film smoothly, like a pro, but on the cheap.
Dollies or vehicles are expensive to hire. Get the same effect with a bike (*above*) or steadicam, such as the Steadicam JR (*as Will Cummock is holding*), or a Super 8 camera with a low centre of gravity, such as an Elmo 108. It won't have a socket to operate remotely – use an air cable release. Fix a small video camera such as an Aiptek to the film camera, to preview each frame in real-time.

PHOTOGRAPHY: LEON CSERNOHLAVEK; DAVE LIDWELL

AUTEUR: DAGIE BRUNDERT, GERMANY

Reel to watch: *Turn Baby Turn* (tinyurl.com/6zyqtm9), a lyrical piece about the mutliple meanings of symbols.

Trick to try: Add words or numbers into your film.

After developing the film, fix it on a lightbox, gelatine emulsion side up (identifiable by its dull finish). Heat a needle in a flame and scratch on to the frames – mirror-inverting numbers or letters. Calculate the number of frames for which you need to repeat the shape. Playback speed is normally 24 frames per second; if you want a word to appear for two seconds, scratch it on to 48 frames.

AUTEUR: JOHN CANNIZZARO, UNITED STATES

Reel to watch: *The First Thanksgiving* (tinyurl.com/42vttgw), a stop motion based on an Eddie Izzard skit.

Trick to try: Change the background.

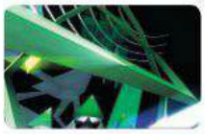
To replace the background of, say, a gravestone that you have already shot, set up a Super 8 projector loaded with the original footage beside a Super 8 camera. Project it on to a translucent screen with a cardboard cutout of the grave behind the screen. Project a new background from a second projector on to the rear of the screen. Front view: the grave stays; background changes. Hit record on the Super 8.

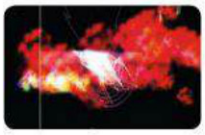
AUTEUR: NAREN WILKS, UNITED KINGDOM

Reel to watch: *Collide-o-scope* (tinyurl.com/6jecg2a), in which a man and his clones jump around a small white room.

Trick to try: Shoot a dreamy time-lapse sequence.

Buy a camera with long-exposure capability, such as the Braun Nizo 561. It should also have an intervalometer, which moves the film at a reduced rate – combine the two for a great effect. It's best to shoot at night as the aperture is open; during the day use a ten-stop (or greater) neutral density filter. Long exposure timelapse sequences are best for filming scenes with a lot of movement.





CLUBBING: MUSIC IN 3D

After Hollywood made the jump to 3D, the rush was on to give everything an upgrade (3D TV! 3D opera! 3D fashion shows!). Clubbing appeared safe – until Novak, a collective of Newcastle-based creatives, launched 3D Disco, a high-tech, globally-touring party.

Clubbers in red-and-cyan shades watch 3D visuals on 3.5m-diagonal screens at eye level around the dancefloor – but with pre-rendered graphics, images can't react in real time.

Andrew Nixon, a 34-year-old partner at Novak, turned to Unity, the software used in games such as *Marvel Superhero Squad*. With Unity, visuals can be altered on the fly. "It's built to react instantly," says Nixon. "It's like playing an instrument live, rather than playing back sections of recorded music. For every beat, say, we could have a circle getting bigger." If 3D graphics operators can immediately alter the imagery, they can react to the crowd and potentially create new shows with other acts. And to think, people used to take narcotics to have 3D visions in discos. CB
novakcollective.com

TIMED TO PERFECTION

WIRED presents the winner of the Balblair photography competition

When we invited readers to enter photographs with the brief "Timed to Perfection", we weren't expecting the standard to be so high. Congratulations to all readers who made the effort to submit images in the hope not just of getting their work published, but also some terrific prizes from Balblair.

In among the action shots, landscapes, portraits and more, one clear winner emerged: Klaus Thymann's photograph of a BMX rider frozen in motion (*above*). Photographer Ed Clark, who judged the competition with WIRED picture editor Steve Peck, said: "It is an extremely dynamic composition, which goes beyond action." He also admired its photojournalistic quality – the way it leaves the viewer asking questions. Thymann wins an all-expenses-paid VIP trip for two to the Balblair distillery, plus a bottle of Balblair 1965 – the oldest and most exclusive vintage whisky from the distillery, worth £1,500. Second prize went to Gregory Jewett (*right*), who won a bottle of each of the core vintages: 2000, 1989 and of course the delicious 1978.

BEST OF THE REST

2ND PLACE
"Gregory Jewett's photograph of a moment in time on the New York Subway (*above*) is visually very engaging," says Clark. "It's intriguing and quite complicated, with a well-balanced palette – the combination of red, white and blue in the shot adds another dimension to it."

To view other entries we liked, work out your own favourite shots from the Balblair competition and get some photographic inspiration, visit: *wired.co.uk/wired-insider*

PHOTOGRAPHY: WILSON HENNESSY

Lo-res big wig

How the creator of Minecraft *developed his blockbuster hit*

Big publishers such as EA and Activision have teams of hundreds working on their blockbuster games. But Markus "Notch" Persson (*right*) created a smash hit by himself. The 32-year-old Swede coded *Minecraft*, a downloadable PC title that's racked up several awards and almost £47 million in sales. There's even been a conference for fans at the Mandalay Bay hotel in Las Vegas. And all while *Minecraft* was in beta.

More and more game designers are making and releasing their own titles. But none has experienced a success like Persson's. It's an especially dazzling feat given that *Minecraft Classic* merely challenges players to dig tunnels and stack blocks into structures in a pixellated lo-res sandbox. "I developed it for people like me," says Persson, "who grew up in the late 80s and early 90s, back when smaller game studios were just exploring the boundaries." It turns out there were a lot of players like him: *Minecraft* enthusiasts fell in love with the game's charmingly retro aesthetic and the easy-to-use toolkit that gave them the freedom to create whatever they could imagine. Persson released a free prototype on the back of a week's development in May 2009 and since then has kept fans abreast of updates. He has more than 465,000 followers on Twitter. Millions happily coughed up when he started charging €10 (£8.60) for the alpha version, then €15 for the beta.

The sold-out Vegas MineCon event marked the official release of *Minecraft 1.0*. Several thousand fans basked in the glow of their guru, but more than four million paying customers worldwide downloaded the update. Persson will continue to work on the game when he isn't managing the company of 13 employees he has now assembled, most of them focused on new titles. (He's overseeing versions of the game for Xbox 360, iOS and Android.) And though he has bought himself a nice watch and a bigger apartment, he largely maintains his low-maintenance coder lifestyle. In fact, most of his fortune remains unspent. "I play games, and it's not that expensive a hobby," he says. "I am slowly learning how to be less frugal." Better be careful in Vegas, player. **David Thomas** *minecraft.net*

BIGGER, BETTER, BLOCKIER

Inside *Minecraft*, players have the freedom to create amazing installations

Minas Tirith from *The Lord of the Rings*

A sculptural tribute to Markus "Notch" Persson

The *USS Enterprise (NCC-1701-D)*

The Taj Mahal

RMS Titanic

ILLUSTRATION: PHYSICAL FICTION. MINECRAFT IMAGES: KINGKRIZ888; MINICHAMPSF1; CASCOLL2000; ARNORITTER1991; FVDISCO

Data mountain

Nasa satellites are helping game designers slash production costs

Winter sports and open data? A gnarly combo – but crucial to EA Sports' *SSX* snowboarding game.

"We wanted 300 tracks," says Todd Batty, creative director of EA Canada. "The first reaction was: we'll need 300 artists. Of course we didn't have the budget for that." So EA turned to topographical information from Nasa's Advanced Spaceborne Thermal Emission and Reflection Radiometer (Aster), on board the orbiting Terra satellite. The dataset covers 99 per cent of the Earth's surface and is available as a free download. EA fed this information into Mountain Man, a proprietary tool that automates the construction of downhill runs. "The technical director Googles the longitude and latitude of Everest, types that into Mountain Man and in about 28 seconds it creates a 100,000-polygon 3D replica of Everest," says Batty. "It probably saved us 30 to 40 per cent of the up-front cost of creating a mountain. And then it saved us a huge amount of work creating the surrounding

PLAY SPORT

HAVE HAWK, WILL TRAVEL

Engine-free flight may well be the point of paragliding – but it sure can foreshorten your sky time. Unless, that is, you fly with a hawk.

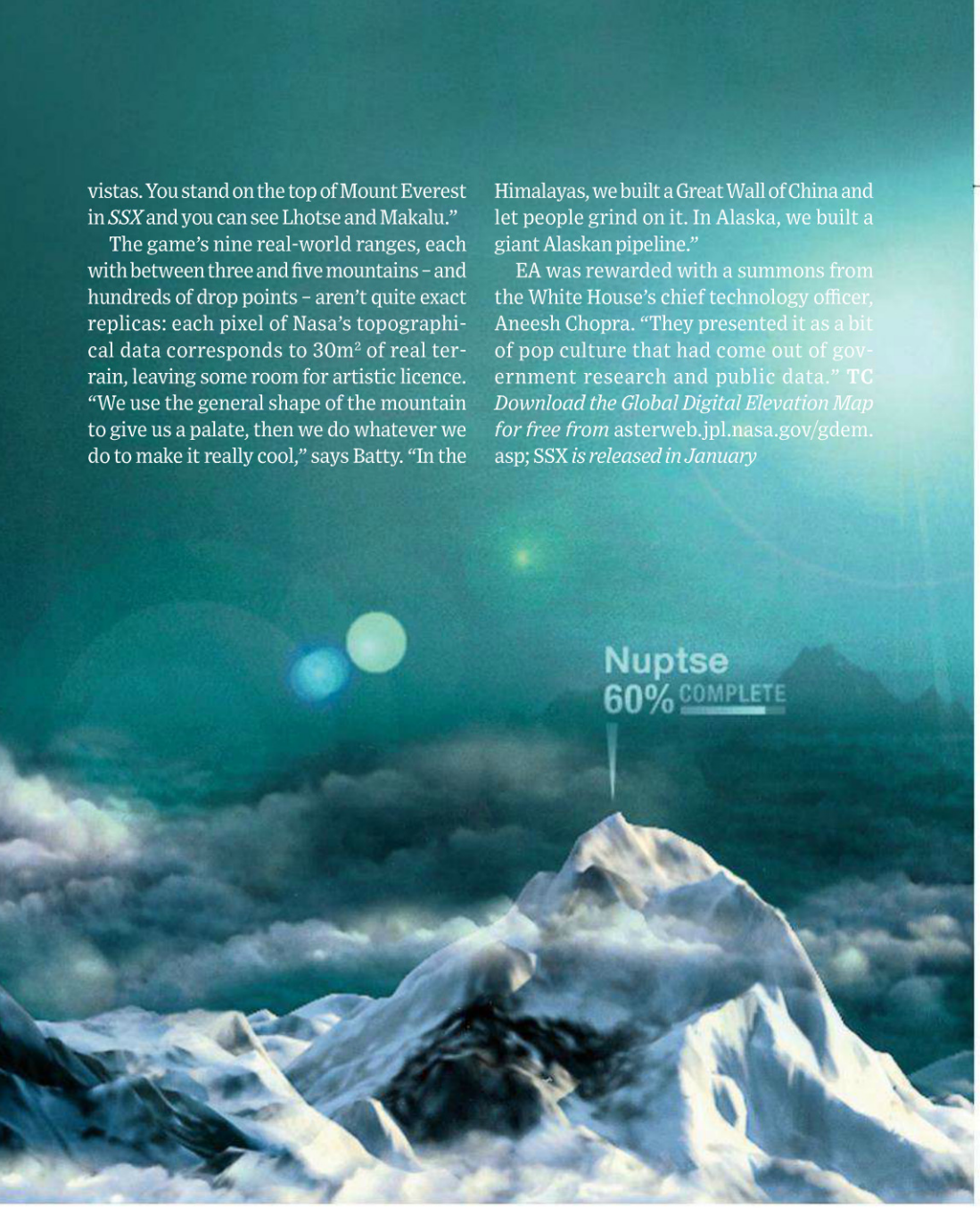
The hybrid pursuit of parahawking was created in 2001 by Scott Mason, a Britain-to-Nepal transplant and falconry expert. "We use Egyptian vultures, black kites and Harris hawks," says Mason, 39. "These birds of prey are naturally good at finding thermals to gain height and preserve energy when they fly." After the paraglider has taken off,

ILLUSTRATION: ROBIN BOYDEN

vistas. You stand on the top of Mount Everest in *SSX* and you can see Lhotse and Makalu."

The game's nine real-world ranges, each with between three and five mountains – and hundreds of drop points – aren't quite exact replicas: each pixel of Nasa's topographical data corresponds to 30m² of real terrain, leaving some room for artistic licence. "We use the general shape of the mountain to give us a palate, then we do whatever we do to make it really cool," says Batty. "In the Himalayas, we built a Great Wall of China and let people grind on it. In Alaska, we built a giant Alaskan pipeline."

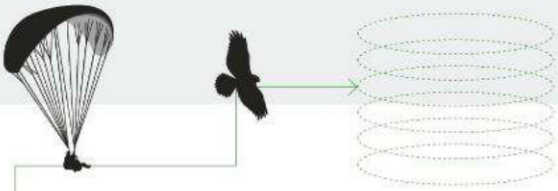
EA was rewarded with a summons from the White House's chief technology officer, Aneesh Chopra. "They presented it as a bit of pop culture that had come out of government research and public data." **TC** *Download the Global Digital Elevation Map for free from* asterweb.jpl.nasa.gov/gdem.asp; SSX *is released in January*



The developers choose a mountain that shows potential for snowboarding

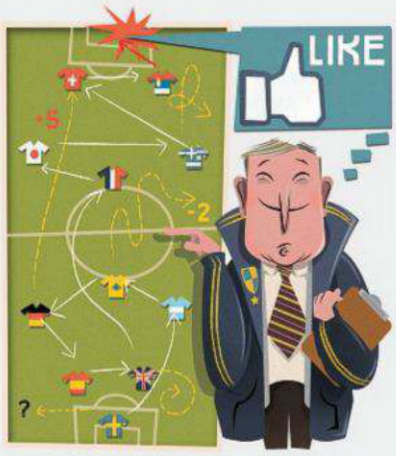
Nasa satellite data is used to create a 3D replica and build runs

The finished game features runs on mountain ranges from across the globe



By following their hawk, paragliders can catch updrafts

a trainer on the ground releases the bird so that it can guide the pilot to rising air, helping the craft to maintain altitude. Occasionally, the creature lands on the pilot's arm to claim a reward of fish or meat (*left*). Now, says Mason, social media and networking services are causing the sport's popularity to soar. "A recent passenger posted a video of his flight last year, which went viral and has been viewed nearly a million times." The season runs until March. CB *parahawking.com*



SPORT: SOCIALLY-NETWORKED SOCCER

Facebook games tend to ask users to spend money at every opportunity. Nordeus, a Belgrade-based developer, focused on free fun in *Top Eleven Football Manager*, but you can still spend if you want to. The tactic has made the game the most popular sports title on Facebook, with the longest "visit" times, but Branko Milutinović, Nordeus's CEO, is cagy about revealing the revenues: "In Serbia," he says, "we don't feel like being in the spotlight." We predict a huge transfer fee... **TC** *topeleven.com*

Playlist

1 COMIC-BOOK CARNAGE

The buzz-baiting new Marvel comic *Carnage USA* features Spider-Man and the Avengers battling Spidey's serial-killer nemesis Carnage. The five-issue limited series is written by Zeb Wells and pencilled by Clayton Crain. *$3.99 marvel.com*

2 IN-DEPTH PHOTOGRAPHY

Move over, conventional cameras. The Lytro captures complete light-field data on each exposure, rather than just a single plane, letting you focus on a shot after it's been taken. No auto-focus = no shutter lag. *From $399 lytro.com/camera*

3 YOU OUGHTA LOVE DAUGHTER

Like Laura Marling's early albums? Then you'll love Daughter: Elena Tonra and Igor Haefeli, a couple whose sparse, acoustic songs are built around her beautiful voice. New EP *The Wild Youth* is out now on Communion Records. *facebook.com/ohdaughter*

4 TABLETOP TANK

Let the TankBot patrol your desk. Running on tracks, this mini vehicle can operate solo using infrared sensors, or, with a free app, be controlled via smartphone. That annoying workmate will never leave sweet wrappers on your desk again. *£24.95 red5.co.uk*

5 PARTY LIKE IT'S 1982

Make beats not war and swap green plastic soldiers for body poppin' b-boys 'n' b-girls. The finest breakdancing moves have been immortalised in fluorescent PVC, but which crew do you join: greens, pinks or blues? *$29.95 kidrobot.com*

PHOTOGRAPHY: DAVE LIDWELL.
WORDS: DAN SMITH

WIRED INSIDER

EVENTS, NEW PRODUCTS, PROMOTIONS AND COMPETITIONS TO LIVE THE WIRED LIFE

COMPILED BY TILLY BULL

1 ORBITSOUND iPHONE DOCK

Orbitsound raises the bar on the "spatial sound" experience with the T12v3. This latest model features a smoother, tighter bass response, improved subwoofer, extended volume range and foolproof installation – so no messy wires or multiple speakers. Tasteful and unobtrusive, it has an iPod dock and also makes a perfect partner for your flatscreen TV. *RRP £299 orbitsound.com*

2 ENTERPRISING U STARTUP COMPETITION

In October, RBS and Find Invest Grow launched RBS Enterprising U (sponsored by LinkedIn). A student business plan competition, it offers over 1.6 million students nationally the chance to pitch their entrepreneurial ideas to a room full of the UK's top active investors. With a chance to win up to £40,000 of investment, it's a great way to kickstart your killer idea. Go to *enterprisingu.com* for entry details

3 GLENFIDDICH 'PIONEERS' SUMMIT

On October 18-20, pioneers of every kind met at the Glenfiddich distillery in Duff, Scotland, to discuss how new technologies and innovation influence the way we live. Attendees included polar explorer Pen Hadow, interactive digital artist Marek Bereza, and chemist, living architecture expert and TED Fellow, Rachel Armstrong. For more, see *glenfiddich.com/pioneers/summit*

4 SEIKO KINETIC PREMIER

Seiko has created a luxurious new range of watches – blending both traditional mechanics with the very latest Kinetic movements. The sleek new Premier line is fitted with an automatic movement running at an impressive 21,600 vibrations-per-hour calibre, and a mighty power reserve of 41 hours. The time relay system ensures accurate timekeeping for up to four years. *seiko.co.uk*

5 *FORZA MOTORSPORT 4*

Xbox owners can drive their dream motor, walk around the Ferrari 458, examine McLaren F1's gold plated engine or simply pop a few bonnets on the most desirable cars in the world with *Forza Motorsport 4*'s new Autovista mode. The controls are pretty racy too – use the standard controller, the wireless speed wheel, or move your head to shift viewpoint with Kinect. *forzamotorsport.net*

PHOTOGRAPHY: SUN LEE

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Hard disk: 2x 2TB - SATA2	Hard disk: 2x 2TB - SATA2	Hard disk: Intel SSD 2x 120 GB
RAID SOFT 0/1	RAID SOFT 0/1	RAID: HARD 0/1 MegaRAID 6 Gb/s
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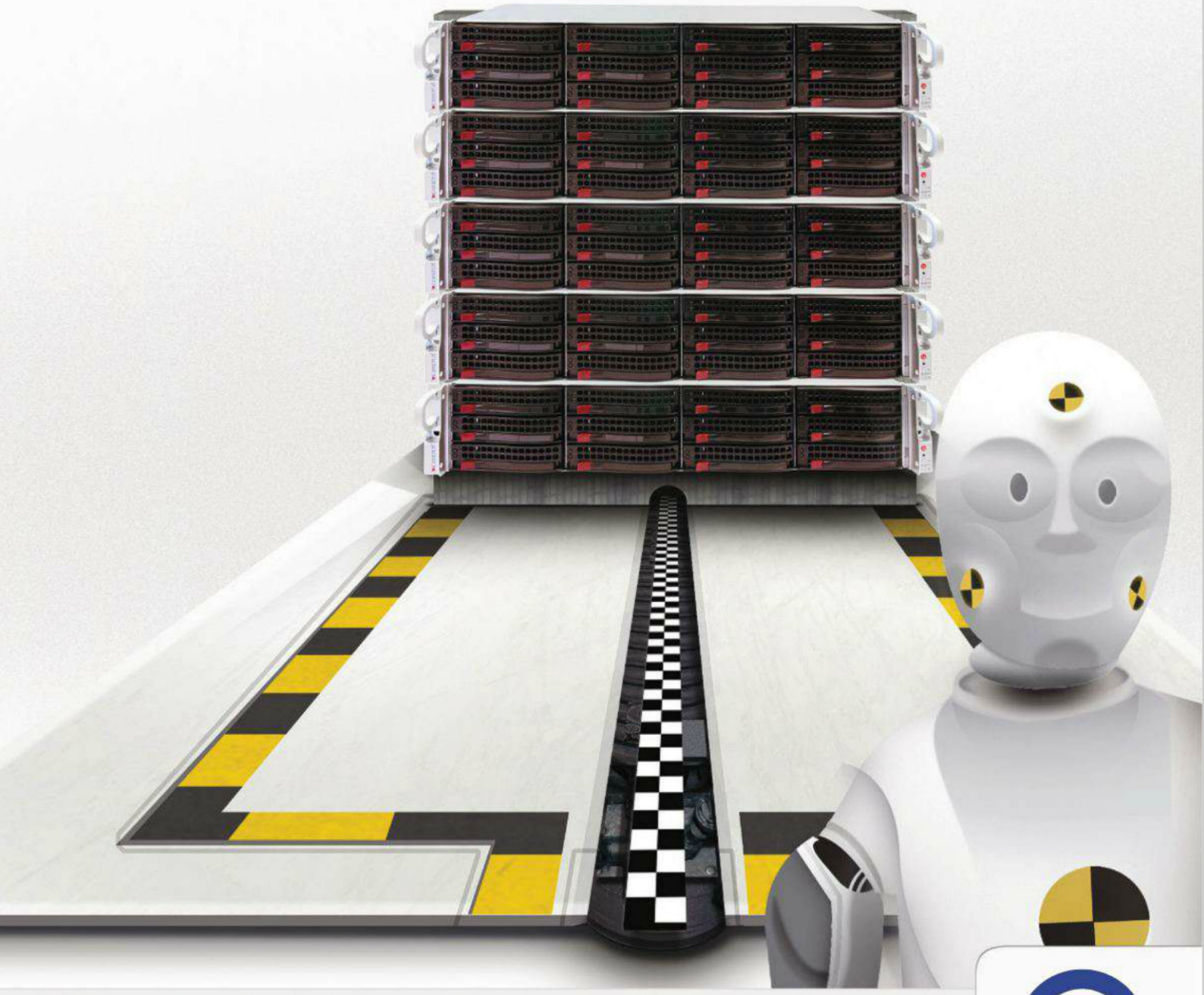

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CREATE MICROGRAVITY

So you'd like to experience zero-G, but you're still awaiting your Nasa credentials. David Chandler's 1991 paper *Weightlessness And Microgravity* can teach you how to recreate weightlessness, without going into space. **Matt Hussey**

● SETTING UP
You'll need an experiment platform – this can simply be a wooden board with a webcam attached. "However, you might also include a 'roll bar' to protect the hardware if the platform bounces and lands upside down," according to Chandler's *Weightlessness And Microgravity.*

●● HIT 'RECORD'
Place a cardboard box with a pillow below to cushion the blow as the platform drops (to achieve 0.6 seconds of microgravity, the drop needs to be two metres). Use a wireless webcam to record the change. Basic video-editing software will let you record and slow down the footage.

●●● LIGHT A CANDLE
There are a number of ways of illustrating the effects of microgravity. The easiest way is to mount a candle to your experiment platform with a black piece of card behind it. Attach the camera to face the candle. When all is ready, light the candle and then drop the platform.

●●●● VIEW IN SLO-MO
Slow down the recorded footage – see the flame go from a long slender flicker to a more squat round flame. During the drop, the hot gas expands in all directions due to reduced gravity, causing the flame to widen. If dropped from high enough, the flame will become spherical and turn blue.

ILLUSTRATION: SILENCE TELEVISION

HOW TO...

COOK DIY *SOUS VIDE*

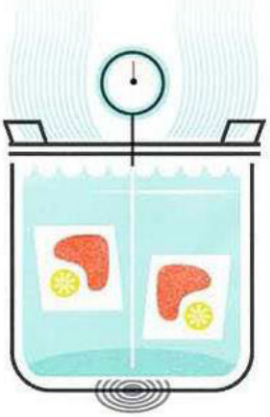
Cooking *sous vide* (whereby food is vacuum-wrapped and slow-cooked in a water bath) can be expensive. Jim Fisher (cookinfrance.com) offers a more cost-effective, but equally delicious, method. Andrew Lowry

● THE EQUIPMENT
The bigger the pot, the more water is involved and so the more consistent cooking will be. "It prevents sharp variations in temperature," says Fisher. Use a sugar thermometer, which you can buy from a specialist kitchen shop.

● ● THE WRAPPING
"Wrap up your food like a Christmas cracker," says Fisher. Six layers is enough. It must be tight – you want heat transferred from one layer to another, without air pockets. "It's also a good idea to season the cling film itself."

● ● ● THE HEAT
Stick to minimum safe temperatures because of health concerns. Chicken needs at least 62°C. Beef and lamb need 58°C to 61°C, veg the late 70s. Be careful with your choices: "The technique doesn't lend itself to green veg."

● ● ● ● THE COOKING
"If the temperature rises, take a cup of cold water and tip it in," says Fisher. The trick is anticipating the temperature increases – it's like running a bath for an infant. Constantly monitor it for half an hour, and then you're done.



HOW TO...

SKETCH YOUR IDEAS IN 3D FOR A CLIENT

Y

ou try to sketch out an idea on paper for a colleague or friend, only for it to result in something not even your parents would stick on the fridge. Trevor Flynn, founder of Drawing at Work (drawingatwork.co.uk), advises: "People have very high expectations, and are very low on forgiveness. But once you can recognise that drawing is a lot about trial and error, that gives you the freedom to play." Ben Beaumont-Thomas

HOW TO...

USE CAMOUFLAGE TO THWART FACIAL RECOGNITION

F

ace recognition is ubiquitous and "freaks most people out", says Adam Harvey. So the New York-based designer created CV Dazzle (cvdazzle.com), a camouflage that prevents computers recognising faces. Tom Cheshire

▲ IGNORE ACCESSORIES
That fedora isn't going to fool anyone. Face-recognition algorithms typically focus on a small triangular area starting above the eyes and down to the chin, widest at the eyes. "That's where most of the information is – ears don't affect it too much, nor does wearing a hat," says Harvey.

▲ ▲ ▲ AVOID ENHANCERS
Enhancers such as eye shadow and lipstick amplify key features. "They make your eyes darker and lips more pronounced. You want to do the opposite," Harvey says. The old adage with make-up is less is more. "You don't want to look ridiculous. Camouflage must not be thought of as a mask."

▲ ▲ GO MONOCHROME
"A lot of face-detection algorithms convert photos into black and white," says Harvey. "When you're applying make-up, it's really about the white and the black, the contrast." He recommends off-the-shelf black-and-white make-up which doesn't crack when it dries. Apply light foundation.

▲ ▲ ▲ ▲ MASK THE T-ZONE
The region where eyes, nose and forehead intersect is "probably the most focused-on area in facial recognition". But there are a few effective ways to fool computer vision. Bring hair down across the eyeline. If you have dark skin, bring down light hair, and vice versa. Or use eye shadow to disguise contours.

ILLUSTRATION: EDA AKALTUNO; GREEN GLASSES: DALE EDWIN MURRAY; MATTHEW HOLLISTER

DRAW THE 2D FACES
"Visualise it first as a 2D drawing," says Flynn. Instead of drawing one big sketch, stock your mind's eye with simple images: "One end, the other end, the top, the sides." 3D will then come more easily.

SCALE IT UP
"You can make a drawing of a bee seem the size of a car by drawing people in silhouette nearby," explains Flynn. "Or cut out a person – collage is important – and stick it near your object."

AVOID STICK MEN
"I advise people not to draw stick men", Flynn says. "It draws attention to the fact you're visually sub-literate." Draw a mummy – that indicates a figure and has some connection to a human.

PERFORMANCE
"Drawing is performance, like acting. You must rehearse," says Flynn. Use the whole gesture of your arm: "Create a good stance and breathe well, or your shoulders hunch and you can't draw."

HOW TO...

TRADE WITH OPEN OUTCRY

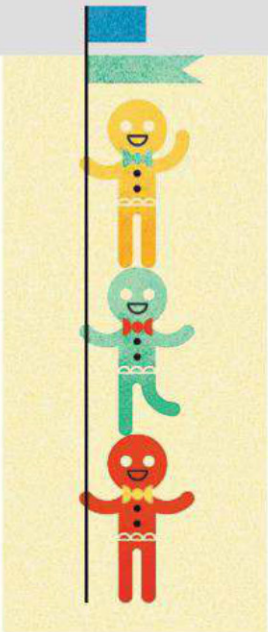
Sure, you can trade stocks online. But it's more fun using hand signals that still run markets such as the Chicago Mercantile Exchange. Take inspiration from Ryan Carlson, a CME trader and founder of tradingpithistory.com. Mark Russell

BUY! SELL!
"The underlying fundamental is: palms inward indicate a buyer; palms outward show a seller," says Carlson. "Extending a hand at arm's length signals the price you want to pay while a hand near the face displays the quantity you want to buy." To avoid confusion, when buying, the price is shown first, followed by the number you want; selling is the other way around.

POINT THE WAY
You think your trading partner may have done the deal with a combination of finger movements and arm positions, but how can you be really sure? To indicate that they're working on it, says Carlson, your partner should use "an index finger pointed outwards, but parallel to the body, and rotated in a circle." This confirms that a deal is being done properly.

HARD TO COUNT
You may deal in thousands, but you need only four fingers and a thumb to express them. "Vertical fingers indicate one to five, and horizontal fingers indicate six to nine; increments of ten are shown on the forehead and single increments on the chin," says Carlson. "Hundreds are a closed fist then a number. For thousands, show the number with your arms crossed in front."

SHOW NO FEAR
You don't want competitors to see your panic if you're in too deep and need to pull the plug. A fist pushed into the palm of the other hand, says Carlson, is the "stop the order" signal. If this doesn't get your message across, you could use the open outcry for a risky options trade called "stupid", performed, says Carlson, "by mimicking shooting oneself in the head".



HOW TO...

HOW TO DISABLE FACEBOOK COOKIES

Facebook tracks you – even if you're not logged in. Its cookies don't expire when you sign out, but are altered to allow the site to keep tabs on your web activity. Here's how to stop Facebook stalking you on different browsers. TC

▲ FIREFOX
Go to Preferences, then Privacy. Click on "Remove individual cookies", underlined at the bottom of the tab. Enter "Facebook" in the search bar – you'll see all the cookies used by Facebook. Select these and hit "Remove cookies".

▲ CHROME
Go to Preferences, then select "Under the Hood" on the left-hand tab. Under "Privacy", go to "Content settings". Go to "Cookie and data exceptions" and add "facebook.com".

▲ INTERNET EXPLORER 9
IE9 doesn't let you be specific about exactly which third-party cookies you can block. So to ban all of them in one swoop, go to "Tools" (the cog in the right-hand corner), "Internet options", "Privacy", then "Advanced". Choose to block or receive a prompt when someone tries to track your web movements instead.

HOW TO...

BE A PRO INTERNET GAMBLER

Internet gambling is not as glamorous as in a casino, but it's likely to be more lucrative. Launch a new career on the betting sites with the help of winonsports.com founder and pro better Tony Ansell. Leila Johnston

●
PICK YOUR TERRITORY
Start with sport, Ansell recommends: "Specialise in a minority sport that you are knowledgeable about. When you spot a weakness in bookmaker pricing you've probably found your area of operation."

●●●●●
PLAY THE LONG GAME
However tempting they look, try to see past the short-term benefits of the offered odds. Bet on your own expectations, says Ansell: "Long-term profits will take care of themselves if you bet in this way."

●●
AVOID ONLINE POKER
Beginners tend not to fare very well at this game. "You will be easy prey for the professionals, who take all the money from the low-stakes tables en route to high-stakes games," says Ansell.

●●●●●●
AVOID TIPS
Betting on a tip is a bad idea, although Ansell concedes that they can confirm your calculations. "If you find an expert odds compiler, you can use their opinion as additional confidence in your own bet."

HOW TO...

CREATE A FIRE TORNADO

Tornadoes form when warm, wet air tries to rise above colder, drier air in a column. A fire tornado, on the other hand, forms through a combination of wind, low humidity and an abundance of fuel – or a collection of household objects and a willing participant. You should probably try this one outside... MH

THINK BEFORE YOU ACT
It's easy to get click-happy when gambling online, so plan carefully. "Decide in advance what you are going to bet on," says Ansell. "Don't chase losses or be seduced into further bets for the sake of it."

MANAGE YOUR BANKROLL
Ansell advises you start with 250 "points", with the goal of winning 10 more per bet. By risking a few points at a time, your money will last longer and you'll learn what works and what doesn't.

BE YOUR OWN BOOKIE
Calculating expectation will improve your chances, as Ansell explains: "Expectation equals your percentage in a 100 per cent book multiplied by the decimal price, including the stake."

DON'T PANIC
"When you start to feel under pressure, if your heart is racing or you have the urge to try to get your money back on a losing day – stop," says Ansell. "Turn the computer off. Tomorrow is another day."

PICK YOUR EQUIPMENT
"The key to making this work is to test a number of circular rotating trays, or Lazy Susans," explains science author Steve Spangler. You'll also need a metal mesh screen like a fire guard, wire, a glass dish, bits of sponge or firelighters, and a dinner plate to cover the fire when finished.

LIGHT THE FIRE
Place the small dish in the centre of the tray, along with your pieces of sponge, or firelighters. If using a sponge, you'll need to use lighter fluid. "Light the fire, but leave the mesh screen off the rotating tray. Notice how the fire spins, but no tornado effect is created.

SCREEN TEST
Roll the mesh screen into a cylindrical shape, so it's smaller than the rotating Susan. "It's best to keep the height of the screen tube between 75cm and 90cm tall. Anything taller carries the risk of falling over as you spin." Secure the mesh with wire or a stapler.

YOU'RE READY TO TWIST
Repeat the process, this time with the mesh placed on the tray. The fire will rise in a column, giving off the appearance of a tornado. "The rising hot air collides with the rotating screen, the momentum of which is transferred to the air molecules, giving them a twist." says Spangler.

ILLUSTRATION: ROBIN BOYDEN; MARK LAZENBY; PARKO POLO; JOHN DEVOLLE

HOW TO...

GET A BIG COMPANY TO LISTEN TO YOUR COMPLAINT

Life as a consumer comes at a price: the tech-support call to Bangalore. You could use gethuman.com to help you bypass phone trees, but you could still languish on hold while waiting for a rep. You need tenacity – and a few dirty tricks.
Christopher Null

GO STRAIGHT TO WEBCHAT
Customer service typically comes in three formats: phone; email; and webchat/instant message. Give chat a try: the support reps managing it typically have better training and usually work harder to help you.

SHARE YOUR PAIN ON FACEBOOK
Companies hate having negative feedback left on their social-network pages. A well-placed post can get a response in minutes from a panicked VP. If your complaint is deleted, kick up a stink about that, too.

TWEET FROM THE ROOFTOPS
Griping on Twitter is useful as companies cannot delete your posts. Direct your wrath at the right @account, use a clever #hashtag, and don't stop – keep a running commentary until you get a result.

MAKE A YOUTUBE VIDEO
After months of complaining to Tiger Airways about lost luggage, singer Dale Watson uploaded a video to YouTube about his plight, namechecking the PR reps who failed him. He soon got reimbursed.

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ON SALE JANUARY 5

WIRED

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ILLUSTRATION: CARL DE TORRES

ALSO ON THE iPAD

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THE OPEN-DATA ECONOMY
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SOCIAL DESIGN
BIOART
FOR
2012
GENOME HACKING
BIOMECHANICS
3D SURFACES
WIRED HAS SCOURED THE CLOUD AND RANSACKED LABS TO FIND OUT WHAT COULD TRANSFORM OUR LIVES IN 2012 AND BEYOND
CORPORATE LONG-TERMISM

1 ALWAYS-ON SOUSVEILLANCE

When Mans Adler founded Bambuser, the Stockholm-based service that lets people broadcast live video online from their mobile phones, the idea was to help users share their lives with friends in real time. But that was before the Arab Spring. When Egypt's political powder keg exploded in January this year, pro-democracy demonstrators discovered that using Bambuser could beat the secret police. If a protester filmed an incident of police brutality, it didn't matter if they were arrested and their phone confiscated: the footage was already live.

The Arab uprisings showed that the use of video as a monitoring tool has shifted decisively. Throughout the 90s and 00s, civil libertarians worried about governments and corporations slapping CCTV cameras all over our towns and cities. But now those tools are being democratised, and we are witnessing the birth of something else: sousveillance.

The monitoring of events, not by those above (*surveiller* in French), but by citizens from below (*sous-*), "sousveillance" was coined by Steve Mann, a pioneer

in wearable computing at the University of Toronto. In the 90s, Mann rigged a head-mounted camera to broadcast images online and found that it was great for documenting everyday malfeasance, such as road potholes. He also discovered that it made security guards uneasy. They'd ask him to remove the camera. When he wouldn't, they'd escort him away. "I realised that this is the inverse of surveillance," he says.

Granted, omnipresent recording is a double-edged sword: when activists posted videos of the protests in despotic Middle Eastern states, government agents used the footage to identify and target dissidents.

But sousveillance will not go away, and new tools are arriving that will enable citizens to document incidents in new ways. Media critic Dan Gillmor envisions software that stitches together video footage from several people to recreate an event in detail. Meanwhile, Witness – a pressure group that supports the use of video for defending human rights – is working on software that blocks out faces so dissidents can film without endangering those in the viewfinder.

And bearing witness will get easier. Always-on wearable videocams, such as the Looxcie, have hit the market and are on the rise: pop one over your ear like a Bluetooth headset and it'll capture a rolling five-hour buffer of everything you see and do, publishable to Facebook with a single click.

Today, we can record everything. All we now need is a social code for doing so. **Clive Thompson**

2 NEUROCINEMA

San Diego-based company MindSign Neuromarketing says that it can ensure every film delivers its desired effect – using neuroscience. Run by Philip Carlsen and Devin Hubbard, MindSign asks testers to watch a film while lying inside a functional magnetic resonance imaging (fMRI) scanner. The machine detects the brain's blood-oxygen levels, which indicate changes in neurological activity. MindSign then breaks down the results into one- to two-second segments to reveal an audience's reaction at any given moment.

Some directors may use this simply to crank up the fright factor, but MindSign says it can offer more subtle diagnostics, such as keeping censors happy while pinpointing just a few seconds of neuro-affecting footage. One drawback: the *Saw* franchise could now go on forever... CB

4 THE NEW HAPTICS

There's not much touch in a touchscreen: you swipe or tap the glass or plastic, but the feel of a button isn't there. Yet.

"It's a human instinct to feel, and the touchscreen is lacking that," says Ville Mäkinen, CEO of Senseg, a Finnish startup that creates haptic screens. Its technology sparks opposing charges between screen and finger, pulling the digit towards the screen. By modulating that force, Senseg can replicate, albeit faintly for now, the sensation of touching different surfaces and materials.

Progress is being made elsewhere, too; Chris Harrison, a researcher at Carnegie Mellon University, has demonstrated a virtual keyboard that uses air to raise keys, and Silicon-Valley startup Tactus has developed a screen that lifts keys by concentrating a fluid sandwiched within the smartphone screen. Oh, and Microsoft and Disney have also joined the race to consign the keyboard to history. It's within touching distance. **TC**

3 CLOUD GAMING

Credible alternatives to music piracy may have come too late for record labels – British Recorded Music Industry (BPI) figures reveal that in 2010, 76 per cent of tracks downloaded in the UK were obtained illegally. However, the video-game industry, which is worth around £30bn globally, is hoping to avoid a similar fate by heading to the cloud. OTOY, OnLive, Happy Cloud and Gaikai are cloud-based services offering consumers a way to access games without downloading software or buying it in shops. Instead they stream games to desktop computers, tablet devices and TV sets (with additional hardware), much like LOVEFiLM's online service. And because the games don't exist as files on a disk, they're harder to crack and distribute illegally over filesharing sites.

"Eliminating piracy is a win for developers," says Jules Urbach, founder and CEO of OTOY. "But developing a game once and having many devices run the same version of that game is a huge win for both gamers and developers."

OnLive, which launched in the UK in September, offers full play passes for new titles such as *Deus Ex: Human Revolution* for £34.99. Expected next year, OTOY is yet to announce its pricing, but they'll likely mirror US numbers – up to 25 cents (16p) per hour of streamed gaming. Lag is an obvious concern, but Urbach claims it shouldn't be an issue with OTOY. "We developed our own codec from scratch, specifically to handle cloud rendering at thousands of frames per second," he says. "The resulting lag is not really perceptible."

Still eagerly awaiting your box-fresh PS4 or next-generation Xbox? Dan Smith

5 WIRELESS MIND CONTROL

In Massachusetts Institute of Technology (MIT), a mouse sits in a lab wearing a hat. But this is no fashion statement; the headpiece is allowing scientists to steer the rodent's movements. It is the latest innovation in optogenetics: controlling animals using light. By illuminating neurons that have been loaded with light-sensitive proteins, scientists can trigger specific bursts of brain activity and direct their subjects' behaviour. This used to require a tangle of clunky optic fibres, but Ed Boyden, a founder of optogenetics and leader of the Synthetic Neurobiology Group at MIT, has made his technique wireless.

Boyden's mind-control helmet runs 16 LEDs from wireless power, and can be controlled from a USB base station. He is able to control the roaming rodents over long periods of time, and can scale up neuroscience by controlling dozens of them at once in order to study long-term processes such as sleep, epilepsy or even Alzheimer's. His work may go on to inform the better design of pacemakers or electrical implants for controlling the symptoms of Parkinson's disease. Hats off to the MIT mice. **Ed Yong**

SPOT ILLUSTRATIONS: JEREMY SLAGLE

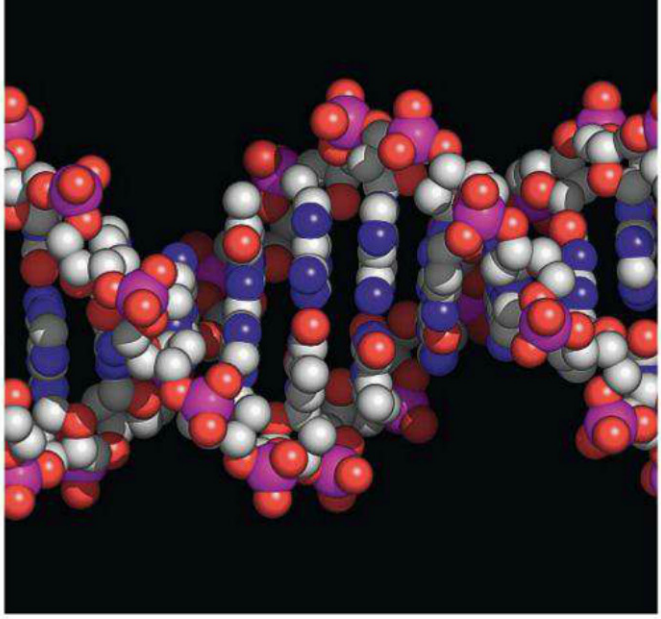
6

CROWD RESTORATION

As digital production becomes standard in Hollywood, many classic films are being left to rot in archives around the world. But Mark Cousins, a film writer and documentary director, has a plan to save them from obscurity: crowdsourced restoration, whereby volunteers use their personal computers to return damaged films to their former glories.

"Film restoration is incredibly labour-intensive, as the average movie contains 140,000 individual frames," Cousins explains. "But we could take a film, find 10,000 people around the world to jointly restore it, send each of them 14 frames and ask them to erase scratches and increase chroma levels."

As with all self-respecting directors, Cousins has a wish list: the 1950 East German film *Das Kalte Herz* (*Heart of Stone*), the 1926 Japanese horror *Kurutta Ippêji* (*A Page of Madness*), and the work of the great Indian director Mani Kaul, who died earlier this year.
Adam Dawtrey



7 / EPIGENETICS

Is it nature or nurture that determines who we are? For years, geneticists would answer the former, but the scientific community is beginning to agree that an amalgam of environment and behaviour affects how our genes act, in a process known as epigenetics.

Studies show that a gene's expression can be amplified or dampened by prolonged exposure to a stressor or catalyst, such as obesity, starvation, smoking or alcohol abuse. These changes happen outside of, or above (hence *epi-*), the genome – without altering it – yet it appears the changes can be passed on to subsequent generations. Lars Olov Bygren, a preventive-health specialist, found that children of parents who suffered famine in their childhoods had shorter lifespans. He also found this to be the case for the children of fathers who smoked in their teens, despite giving up before conceiving. This phenomenon is explained by the memory or "mark" of the epigenetic alteration being passed on to the successive generation, not changes to the DNA coding.

Scientists are learning to manipulate these marks, by silencing "bad" genes and kick-starting others. They should soon be able to focus on genes that trigger diseases such as cancer, schizophrenia and Alzheimer's. An analogy in the field is: if the genome is the hardware, the epigenome is the software. All we need are the right coders. **DS**

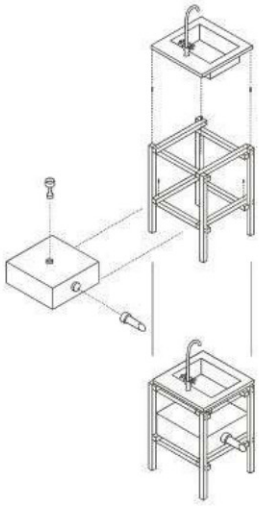
8

OPEN-SOURCED CONSTRUCTION

Think you can offer an alternative to IKEA's flat-pack hegemony? OpenStructures, created by Belgian designer Thomas Lommee, is a furniture-construction model that enables collaborative design. The company lets users share a base grid online on which they can contribute suggestions, from design to construction.

In this spirit, Holland-based company Droog has launched Design for download, a web portal where users can download designs, adapt them, then upload them to be built.

"I don't think that it will become the dominant way of buying furniture, but it could develop," says Renny Ramakers, a Droog director.
Tim Abrahams



Right
OpenStructures aims to "enable collaborative innovation, stimulate reuse cycles of parts and components, and generate flexible puzzle structures"

PHOTOGRAPHY: CORBIS

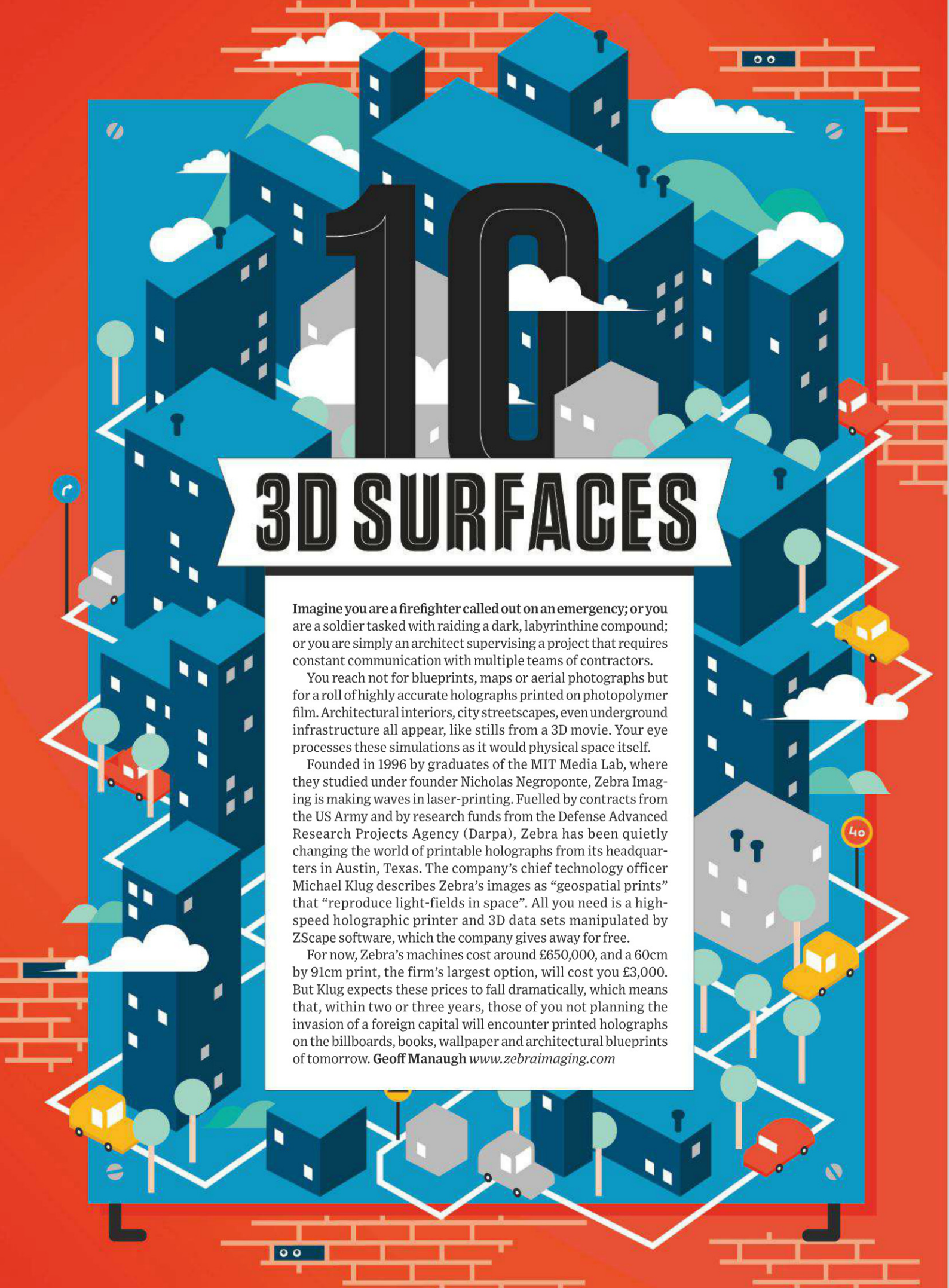
9

OLYMPIAN BIOMECHANICS

Biomechanics trainers are on hand to ensure Olympians will shape up and be in absolute peak condition for London 2012. "There are two types of biomechanics," says Martin Haines, chairman of the UK Biomechanics Coaching Association (UKBCA). "Extrinsic biomechanics assess how well you perform a task or movement; intrinsic biomechanics shows how the body is stacked up in mechanical terms and determines your capacity to perform extrinsic movements."

UKBCA teaches the coaches and trainers working with Team GB's gymnastics and triathlon teams. Along with using super-slow-motion video, their techniques for extrinsic biomechanics include using robots to measure muscle force, and lumbar monitors to display how the spine is functioning.

Using these, coaches can spot areas in which a javelin thrower, for example, could better align themselves to throw further. But intrinsically, they may also be able to discover old injuries that need care or sensitive nerves to treat. "You'll hear athletes say 'my training was going well then this injury came out of nowhere,'" says Haines. "But the injury often comes from their poor intrinsic biomechanics and was a problem waiting to happen." DS



10 3D SURFACES

Imagine you are a firefighter called out on an emergency; or you are a soldier tasked with raiding a dark, labyrinthine compound; or you are simply an architect supervising a project that requires constant communication with multiple teams of contractors.

You reach not for blueprints, maps or aerial photographs but for a roll of highly accurate holographs printed on photopolymer film. Architectural interiors, city streetscapes, even underground infrastructure all appear, like stills from a 3D movie. Your eye processes these simulations as it would physical space itself.

Founded in 1996 by graduates of the MIT Media Lab, where they studied under founder Nicholas Negroponte, Zebra Imaging is making waves in laser-printing. Fuelled by contracts from the US Army and by research funds from the Defense Advanced Research Projects Agency (Darpa), Zebra has been quietly changing the world of printable holographs from its headquarters in Austin, Texas. The company's chief technology officer Michael Klug describes Zebra's images as "geospatial prints" that "reproduce light-fields in space". All you need is a high-speed holographic printer and 3D data sets manipulated by ZScape software, which the company gives away for free.

For now, Zebra's machines cost around £650,000, and a 60cm by 91cm print, the firm's largest option, will cost you £3,000. But Klug expects these prices to fall dramatically, which means that, within two or three years, those of you not planning the invasion of a foreign capital will encounter printed holographs on the billboards, books, wallpaper and architectural blueprints of tomorrow. **Geoff Manaugh** *www.zebraimaging.com*

11

DRONE HACKING

That buzzing sound overhead – an innocuous aircraft, right? Or is it a drone with designs on your data? US-based security consultants Mike Tassey and Richard Perkins have shown that you don't need government talent or military coin to build an unmanned aerial vehicle (UAV) that can hack into wireless networks. They have made their own Vespid drone, which cost less than $500, and fitted it out with a 100MW wireless card, a high-gain antenna and a computer.

The drone has onboard tools for performing hacks. "Even if we can't access a [Wi-Fi] network directly by breaking the encryption, we can cause a denial of service condition," says Tassey, 35. This kicks all computers off the network. If, unwittingly, they reconnect via the UAV, the pair can snoop. Alternatively, the drone can impersonate a mobile-phone carrier: "We can entice phones to connect to our 'cellular tower', and redirect and listen in to calls, intercept SMS messages, and cause denial of service for cellular clients," he says, adding that they test the UAV only on their own kit.

They say their drone is merely to alert people to a new hazard: "Think about it in terms of terrorism. We chose computers as our payload, others may choose something worse." **CB**

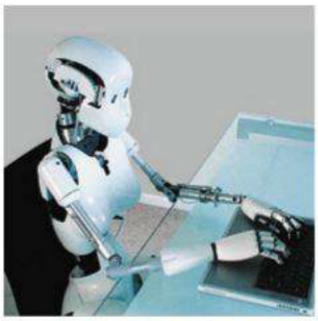
12 / ROBO WRITERS

"AN OWN GOAL BY LIVERPOOL GOALIE JOSÉ REINA IN THE 90TH MINUTE ALLOWED ARSENAL TO ESCAPE WITH A 1-1 TIE ON SUNDAY AT ANFIELD. LIVERPOOL HAD SPENT THE ENTIRE SECOND HALF DOWN A PLAYER AFTER REFEREE MARTIN ATKINSON GAVE MIDFIELDER JOE COLE A RED CARD FOR HIS TACKLE OF LAURENT KOSCIELNY AT THE VERY END OF THE FIRST. STILL, LIVERPOOL MAINTAINED A 1-0 ADVANTAGE FOR MOST OF THE SECOND HALF..."

Above is a typical sports story. Except it's not – a machine wrote it. Narrative Science, a Chicago startup that launched in 2010, generates narrative content from data: no humans required. "We write long-form stories, abstracts of stories, tweets, and headlines," says CEO Stuart Frankel.

By "we", he means the Authoring Engine, a technology created by journalists and engineers from the Windy City's Northwestern University. They worked on the front end of the system, generating story types for the sectors the company covers: financial, sports and property news. "Then we map them on to a set of configurations for a system that's ingesting data and look for inflection points." The platform identifies those points, gathered from sources such as Opta, to build a collection of possible angles, which are ranked to create a structure. It then generates up to 1,000 words of copy.

Narrative Science is not alone in the robotic writing revolution: MarketBrief, a Y Combinator-backed startup, automatically converts Securities and Exchange Commission filings into stories, seconds after they are released, 1,000 times a day. The tech is still young (until a robot passes the Turing test, interviews will remain tricky) but Frankel claims Narrative Science can already produce 20 per cent of a newspaper's content automatically. "More and more data is becoming available," Frankel says. "If there's data, we can tell the story." Uh-oh. **TC**



13

RETRO-FITTING THE CITY

When London was being built, energy efficiency wasn't a massive design factor. But with buildings now accounting for 80 per cent of the capital's carbon emissions, structures in London and beyond are getting a green upgrade. Retrofitting is the refurbishment of old buildings with smart systems for energy use, such as PC shutdown controls, insulation and draftproofing, photovoltaics (generating electrical power by converting solar radiation), solar water-heating or combined heat and power units.

This year, a retrofit at the second-highest building in the world, Taiwan's Taipei 101, earned it the top green building rating of Leadership in Energy and Environmental Design (LEED) Platinum. The Empire State Building's retrofit should slash its energy use by 38 per cent when complete next year, with five per cent coming from window replacement alone. The Obama administration estimates that retrofitting buildings could save US businesses $40 billion (£25 billion) annually on energy bills, and the Clinton Climate Initiative is backing retrofit projects from Mumbai to Melbourne. London Mayor Boris Johnson's RE:FIT programme is modding public buildings, which account for ten per cent of the city's emissions.

But won't a retrofit mean that the look of cities stays frozen, creating "urban museums" like Venice or Edinburgh? Gordon Gill, partner at AS+GG, the architecture practice behind the Chicago Central Area DeCarbonization Plan, thinks not. "Cities will always evolve," he says. "But in strategic ways." **TA**

THREE WORLD-LEADING RETROFITS

Daley Center, Chicago
A $7 million project is spearheading city-wide Windy City retrofits

Ilford Fire Station
The first building to take part in London's RE:FIT programme

Inorbit Mall, Mumbai
Post-retrofit, this megamall's energy use will fall by 17 per cent

14

THE OPEN-DATA ECONOMY

For years, proponents of "government 2.0" have been calling for the liberation of public data. Gigabytes of information about crime, health, money and the weather are gathering dust somewhere, so why not release them so we can build civic-life-improving apps?

A bunch of US entrepreneurs have started to make inroads: San Diego-based brothers Mike and Ryan Alfred launched BrightScope in 2008 after realising that, whereas Americans have more than $4 trillion (£2.5 trillion) invested in pension plans, there is no independent agency that compares their employers' plans with those at other firms. By law, US pension plans have to report their annual results to the Labor Department, so the Alfreds coaxed it to release that data, and then got crunching. Soon they had created analyses so valuable that financial managers pay tens of thousands of dollars for a peek. BrightScope did more than $2 million in business in 2010 and now employs 30 people. "Without that public data, there's no company," Mike Alfred says.

Others are pulling similar tricks. In 2009, a trio of Wall Streeters created the *MyCityWay* app by cleaning up and bundling data feeds from 20 US cities, including restaurant-inspection reports, swimming-pool hours, train schedules, even traffic-cam videofeeds. It's been downloaded more than a million times.

So how do we get the attention of the UK government? One word: money. Shoving more public data into the commons could kick-start billions in economic activity. Because data becomes incredibly valuable in the hands of the right entrepreneurs. CT

PHOTOGRAPHY: ALAMY

15

THE LAB

ON A POSTAGE STAMP

Doctors could soon carry a life-saving laboratory in their pocket, thanks to the practice of microfluidics: controlling fluids through intricate patterns engraved on plates of glass. Micrometre-wide channels in the devices allow scientists to control a single drop of blood or saliva, guiding it through a circuit of precursors, mixing chambers and reagents to aid diagnosis. These miniature labs are both cheap and rugged, making them especially suitable for areas where access to real laboratories is limited.

New York's Columbia University recently trialled the mChip, a 65p instant diagnostic test for HIV and syphilis, designed for doctors working in developing countries. And UK startup Molecular Vision is currently working on a device that can run multiple tests simultaneously. "If you can test someone in an ambulance on their way to hospital, or in A&E, that's a big benefit," says Molecular Vision CEO Dr Chris Hand. "It's all about getting care to the patient more quickly and efficiently." **Frank Swain**

16

BIOART

We're familiar with the concept of life as art. What about living skin and blood cells as art? A wave of collaborations between artists and biologists is using animal and human tissues, bacteria and living organisms as materials for works of bioart.

SymbioticA, a life-sciences lab at the University of Western Australia, has created *Semi-Living Worry Dolls*: tissue-engineered sculptures inspired by tiny Guatemalan dolls that are given to children to dispel their fears. Textiles have been swapped with pig stem cells seeded on to degradable polymers and placed within a micro-gravity bioreactor. During their exhibition, the dolls' cells grow to create 25-milimetre-high fleshy structures.

Other notable bioart includes Kathy High's *Blood Wars*, in which two people's white-blood cells are pitted against each other in a petri dish; Andrew Krasnow's work, which he makes with human skin; and Julia Reodica's *hymNext Hymen Project*, in which the artist grows her vaginal cells into synthesised hymens.

Wellcome Trust arts adviser Jenny Paton says that funding applications for art projects investigating biomedical science have more than doubled since 2006. She attributes this increase to the rise of interdisciplinary practice at universities and the increasing emphasis on science communications.

And to counter any pesky ethical concerns that some may harbour? SymbioticA has that covered: it has devised a symbolic device called "the killing ritual" where they invite audiences to expose the tissue to the external environment, contaminating and consigning the art to the incinerator. **Olivia Solon**

17 / FREE-TO-PLAY

The sequel to your favourite video game might not cost you a penny. Ever-increasing numbers of games publishers are shifting to a radically different business model for their titles – one that neatly skirts around the threat of piracy.

Traditional off-the-shelf games are pay-to-play, meaning you have to pony up before you hit the joystick. Free-to-play is the reverse: you download the game for free, and then can choose to pay small amounts for certain perks, such as faster skill accumulation, get-out-of-jail-free cards or cosmetic enhancements such as a nice hat for your character.

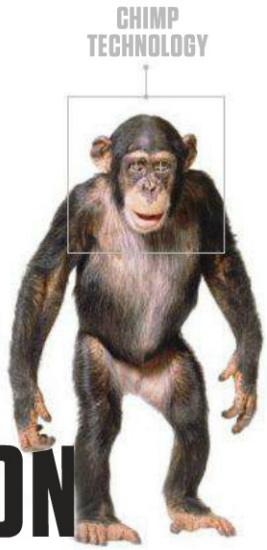
The business model originated in China, Korea and Brazil, where piracy was so prevalent that selling packaged titles was pointless. Then it spread to the UK and US when creators of Facebook and iOS games wanted to make their titles available cheaply but still turn a profit.

Now it's taking the entire industry by storm. More than eight major online games have free-to-play elements either already implemented or in the pipeline. EA has 17 million users on free-to-play games, and at the time of writing seven of the top ten "top grossing" games in Apple's App Store are free-to-play.

Several of those are from a company called Tapjoy. At a panel discussion at the Mobile Games Forum in January, Tapjoy's Paul Bowen told attendees: "If you're making a paid-for game, stop. Make a [free-to-play] game with virtual goods and you'll make five times the money." **Duncan Geere**

PHOTOGRAPHY: CORBIS

18 CONNECTED CONSERVATION



Monitoring the movement and population of different species is crucial for wildlife conservation. It helps biologists to identify the creatures most at risk and to chart management programmes. This data has traditionally been gathered manually, with researchers counting visible specimens, nests or dung in a sample area. Video cameras could monitor wildlife remotely, but an eye was still required to trawl through footage and identify animals using a database.

Now researchers at the Fraunhofer Institute in Munich have developed a system that can rapidly process images of great apes in order to recognise them more quickly in the wild. The program isolates individual faces and captures their biometric data. It supplements this with audio data collected from microphones – automatically classifying sounds such as gorillas' chest-thumping and grunting. This allows the computer not only to identify the species, but also offers behavioural insights. Other animals could almost have been made for electronic recognition. Biologists at Princeton and the University of Illinois have developed an open-source "barcode scanner" called StripeSpotter, which reads and identifies zebras' unique black-and-white markings.

These developments result largely from the falling price of GPS devices, which allows conservationists to track the movements of our primate and ungulate friends, as well as toucans, cuckoos and bats, with relative ease. As Fraunhofer researcher Alexander Loos says: "These new technologies mean that human resources can be allocated to more complex tasks than filling out checklists." OS

GPS devices weighing just ten grams have been attached to bats

19 THE SENSORIMOTOR CIPHER

The mapping of the alphabet on top of numbers on phone keypads has become so pervasive that it affects our understanding of numbers through verbal associations.

Psychologist Sascha Topolinski of the University of Würzburg asked participants in tests to dial numbers on an unmarked phone. He found that people preferred to dial numbers that implied positive words, like 37326 – spelling DREAM. Participants also rated companies as "attractive" if they had phone numbers implying a company-related word, such as 5683 (LOVE) for a dating agency. Topolinski named this the "sensorimotor cipher" and says it is so inescapable that "businesses might manipulate potential customers by choosing a phone number that corresponds to their purpose". **Vaughan Bell**

20 WIRELESS CARS

Wi-Fi at 100kph? According to Pim van der Jagt, MD of Ford Motors' European research centre, car-to-car communication is ready to roll out. Using Long-Term Evolution or Universal Mobile Telecommunications System standards, cars can become moving Wi-Fi hubs.

So why the delay? Among other things, it's the critical-mass factor. "It's only usable if a large percentage of cars is using it," says van der Jagt, who suggests manufacturers may have to offer the system for free for a couple of years to spur adoption. Fine by us... Katie Scott

21 THE CAR AS APP

The newest development in car-industry tech is not alternative power sources or safety systems. It's apps.

"Henry Ford made transportation accessible to everyone," says Jason Johnson, a product-development engineer at Ford. "We want to do the same with technology."

They're not alone: General Motors' OnStar team has developed apps that allow customers to unlock car doors and check fuel levels and tyre pressure using smartphones. Nissan's all-electric Leaf uses a mobile app to warm or cool the cabin, track the vehicle's battery charge and view driving range. And BMW unveiled the i3 in September, a carbon-fibre city car due on sale in 2013, the entire philosophy of which is underpinned by mobile connectivity: smart parking, satnavs, up-to-date information on public transport and car-sharing facilities will all be part of an evolving phone-based package.

Perhaps with an eye on the rocketing value of tech stock, BMW has also launched a New York-based venture capital company, BMW i Ventures, that aims to spot and fund quick-thinking tech startups as personal mobility technology gathers pace.

Ford is busy rebranding itself as a technology company. The sea change at the blue oval began at 2007's Consumer Electronics Show (CES) Awards, when Bill Gates and the newly installed Ford CEO Alan Mulally, a former Boeing executive vice president, announced a joint tech programme called SYNC. An in-car Windows-operated platform that runs apps, it initially just worked via USB and Bluetooth. SYNC has received regular upgrades and now operates in tandem with a user interface called MyFord Touch, which can be operated by voice command, a five-way button on the steering wheel or an eight-inch touchscreen at the top of your cars' centre console.

Ford's apps read SMS messages; they will soon be able to tweet

"We're striving for simplicity," says Johnson. "Our mantra is 'hands on the wheel, eyes on the road.' The previous system recognised 100 commands, now it's 10,000." The technology works with UK, US and Australian English, plus 19 other languages.

Crucially, SYNC can accept the same volume of software upgrades as any comparable piece of hardware, and Johnson is confident of its lifespan in terms of technology, durability and future-proofing. "Will someone be driving this car in 20 years' time? Of course," he says. "And if the stuff in it now isn't working, we'll offer a software upgrade."

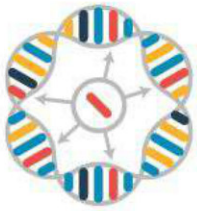
But delivering an iPhone-like swipe screen is trickier. "Temperature and humidity are major issues," says Johnson. "Cars have to work in extreme temperature ranges. Customers in some territories drive wearing gloves so they need to be able to operate the systems with them on. Our products are designed and engineered to last for ten years or 100,000 miles. Does anyone expect their iPhone to last that long?" **Jason Barlow**

22 / GENOME MULTI-HACKING

For years, scientists have been able to alter their organism of choice – as long as it's one or two genes at a time. But Peter Carr and George Church, from Harvard Medical School and MIT's Media Lab respectively, have found a way to make sweeping, simultaneous edits across an entire genome. It is biology's equivalent of find and replace all.

To showcase their techniques, the pair have started to overwrite the genetic code of the bacterium *Escherichia coli*. They have developed 32 strains where each instance of a specific codon – three DNA letters that code for an amino acid – is substituted for an alternative. These strains gradually fuse and the targeted codon vanishes, freeing up some genetic code.

Church and Carr's aim is to tweak codes to make modified organisms that speak a different genetic language to natural ones, making them immune to viruses or unable to breed with wild populations, eventually producing new classes of drugs or enzymes. EY



23 UBIQUITOUS · FACE RECOGNITION ·

Face recognition is now ubiquitous. In June, Facebook rolled out its "Tag Suggest" system, which recognises pictures of users' friends as they are uploaded; face.com claims it has scanned 25 billion images; and Google (which uses face recognition in its Picasa photo-management system) says that, once it gets the legals figured out, *Google Goggles* will be used to identify members of the public by pointing your smartphone at them. Rioters in Canada and the UK have been identified using the technology, and at the 2014 Fifa World Cup, Brazilian police will use face-scanning glasses to automatically identify "persons of interest" at matches.

There are concerns over mission creep. "Recognising people in photographs works well," says BT's chief security technology officer Bruce Schneier. "But attempts to pick terrorists out of crowds have failed, resulting in systems that do a great job surveilling innocents and a terrible job identifying the guilty." Say cheese... **Tom Cheshire**

THREE KEY DRIVING TOOLS

Nissan CARWINGS
Check battery charge, turn on climate control and check driving range

OnStar RemoteLink
GM's app can start your car, turn on its lights and honk the horn remotely

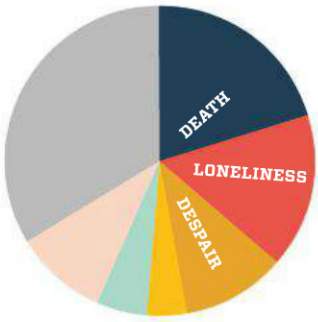
Ford SYNC
"What's this song?" "Call mum," "I'm hungry," This OS can help

24 HERE FOR THE LONG HAUL: CORPORATE LONG-TERMISM

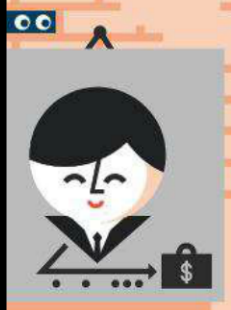
Masayoshi Son, founder of Japan's telecoms and media giant SoftBank, likes thinking ahead. So far ahead, in fact, that in June last year he published a document setting out his company vision for "growth in the next 300 years". The document opens with a pie chart showing death, loneliness and despair in Japan, and a bar graph quantifying the country's rising suicide numbers. It then explains that SoftBank "works to comfort people in their sorrow", and that the next three decades would be "merely the first step" in its mission to "increase people's joy". That's why the nation's official iPhone carrier would devote itself to "making people happy" through what Son calls the "information revolution" – even if that means "think[ing] till our brains crush".

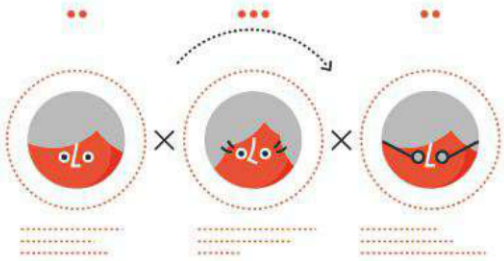
If you are going to pursue such an ambitious corporate strategy, it helps if, like Son, you are not only your company's founder but also its chairman and CEO (and, reportedly, Japan's wealthiest individual). Yet his is far from the only business promoting extreme long-term thinking in the quest for market advantage. This June, IBM took four-page ads in *The Wall Street Journal* and *The New York Times* to share some lessons from its first 100 years as it began its second. "A century of corporate life has taught us this truth," they read. "To make an enduring impact over the long term, you have to manage for the long term." Unilever, too, has shied away from short-term shareholder concerns under CEO Paul Polman. "Unilever has been around for 100-plus years," he told the *Financial Times* last year. "We want to be around for several hundred more years. So if you buy into this long-term value-creation model... then come and invest with us. If you don't buy into this, I respect you as a human being, but don't put your money in our company."

With capital markets ever more focused on short-term advantage, there may indeed be a commercial edge for businesses that can take the longer view. Sure, the Facebook IPO will create a bunch of new billionaires. But how many of them will be thinking 300 days ahead, let alone years? **David Rowan**



SoftBank's vision: "The saddest thing in people's life is loneliness... we work to increase people's joy"





SOCIAL DESIGN 25

FACEBOOK IS ON A GLOBAL MISSION: TO REDESIGN EVERY INDUSTRY, FROM MEDIA TO MEDICINE TO MONEY, AROUND THE SOCIAL GRAPH. BY DAVID ROWAN

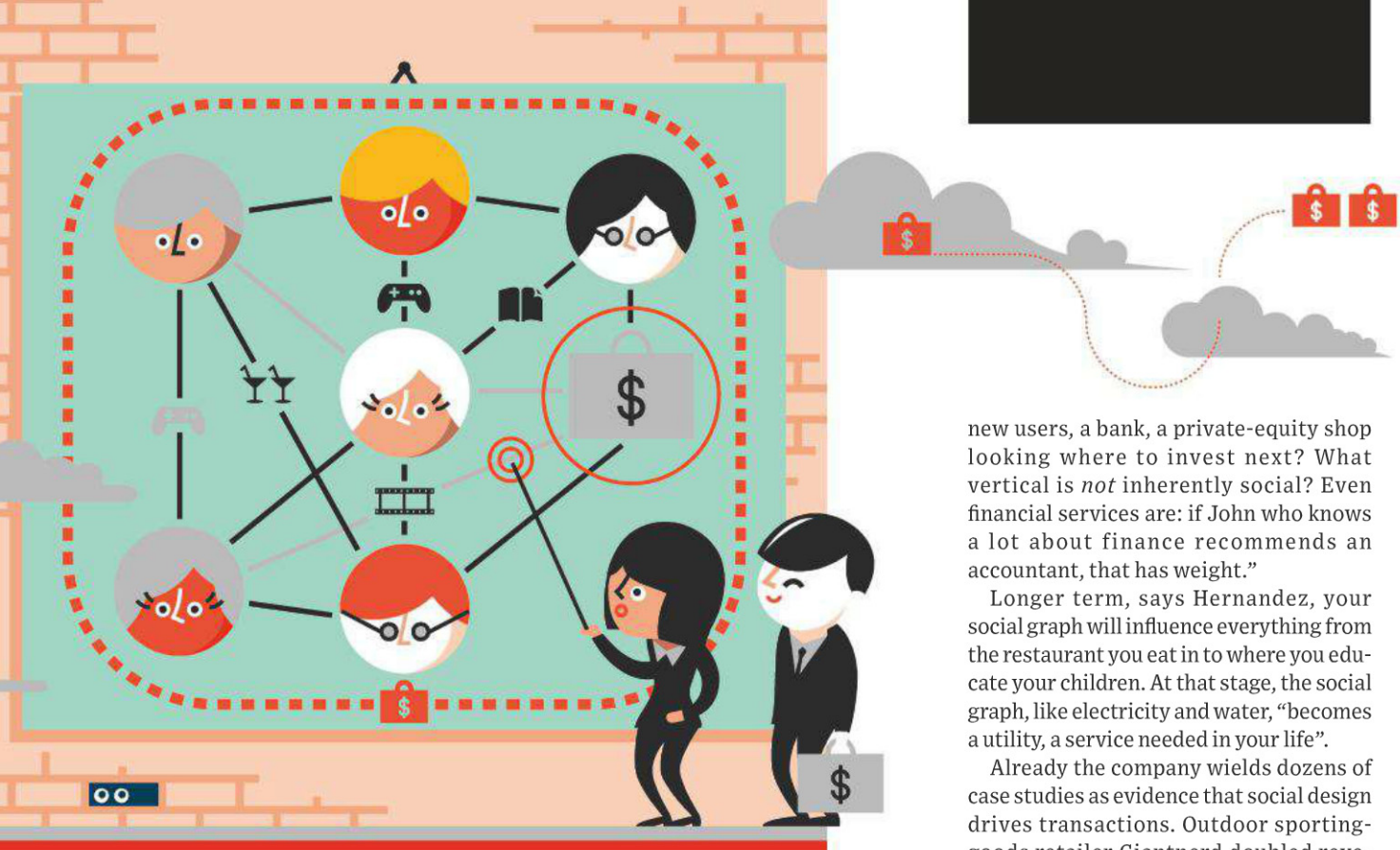
When Mark Zuckerberg took to the stage at the eG8 conference in Paris last May, he explained why social-gaming company Zynga was now worth more than EA, the market incumbent. "They understood that people want to play with their friends [so] they make games with social baked in," said the Facebook CEO. "Gaming is a naturally social thing. Movies, TV, news, books – those are [also] things people just naturally do with their friends. These applications and industries will be more social in the next few years."

One by one, Zuckerberg said, all sorts of businesses would be reinvented around the social graph. "We have this principle that we call social design at the company," he said. "A lot of the ways that you design social products are fundamentally different from the normal interactions that you would design in other products." Take friend requests. Feedback had taught the company to offer "accept" and "not now", rather than a traditional "yes" or "no". "It makes people feel less bad about rejecting requests," he said. "There's a lot of things like that that tap into the social nature of humans. This principle of social design is going to be baked into all of these different social applications going forward."

Welcome to the age of social design. If Facebook is right, industries from media to medical care will need to transform their business processes in response to the dominance of social networks. "At the core of social design is the thesis that the web is being rebuilt around people," says Dan Rose, VP of partnerships and platform marketing at the company. "Over the last five years, as people's identities have moved online, the information web has given way to the social web. They're able to engage with content in a more natural way, through serendipitous interaction with friends and acquaintances. We're moving from the 'what' to the 'who', from the wisdom of crowds to the wisdom of friends."

The term, championed internally by VP of product Chris Cox, emerged from the unexpected success of Facebook's photo-tagging app. Within months, the ability to share photos socially had made Facebook the web's largest photo library. "When Mark saw the success of the photo application, he thought about all the other products that could benefit from making them social," Rose says. "The list was too long for us to do ourselves. That's why we launched the Facebook platform – to unlock the

Redesigning your business: Facebook CEO Zuckerberg



‘WE’RE MOVING FROM THE WISDOM OF CROWDS TO THE WISDOM OF FRIENDS’ – DAN ROSE, FACEBOOK

innovation of other entrepreneurs. Every category on the web will be impacted by this new design principle.”

First came gaming, then online retail and media. “From there, every business on the internet can be designed around putting people at the centre – commerce, travel, all can be rethought,” says Rose. In practice, it typically involves letting friends influence each other based on their purchasing or browsing history or “likes”. Spotify lets you discover the music your friends like; room-rental service Airbnb lets you filter transactions through friends whose friends may have stayed there; Trippy lets you plan a journey around personal recommendations; Appsfire lets you know what apps your peers are downloading; Flipboard turns links recommended by friends into a personalised digital magazine.

“Every company we engage with has a question at board level about what their Facebook strategy is,” says Christian Hernandez, the firm’s head of international business development. “What does it mean for a utility company trying to get new users, a bank, a private-equity shop looking where to invest next? What vertical is *not* inherently social? Even financial services are: if John who knows a lot about finance recommends an accountant, that has weight.”

Longer term, says Hernandez, your social graph will influence everything from the restaurant you eat in to where you educate your children. At that stage, the social graph, like electricity and water, “becomes a utility, a service needed in your life”.

Already the company wields dozens of case studies as evidence that social design drives transactions. Outdoor sporting-goods retailer Giantnerd doubled revenue through Facebook within two weeks of adding the Like button, it says; social-recruitment service BranchOut, through which friends are recommended for jobs, grew from 10,000 to 250,000 users in a month. The model will transform traditional expectations of advertising, Hernandez predicts. “Today you target ads to me based on a cookie, which is based on assumptions,” he says. “If I’m 34 and female or 24 and male, that should trigger different commercial offers. It doesn’t. Social design will at some stage catch up and better target the consumer.”

On the Facebook developers’ blog, a post (Liked 17,157 times) explains that social design consists of three elements: identity, conversation and community. “Community refers to the people we know and trust and who help us to make decisions,” it says. “Conversation refers to the interactions we have with our communities. Identity refers to our sense of self and how we are seen by our communities.”

Privacy advocates worry about the intrusive nature of such thinking. *The Wall Street Journal* recently reported that widgets such as the Like button can potentially track internet users and link their web-browsing habits to their social-networking profile, even if they do not click the Like button. But Dan Rose is on a mission. “This is the most important thing we’re working on in terms of the Facebook platform,” he says. “Our focus is to enable lots of companies and lots of industries to reinvent their product and their business through the lens of people and friends. The next 12 months will unleash a huge number of companies doing this.” W

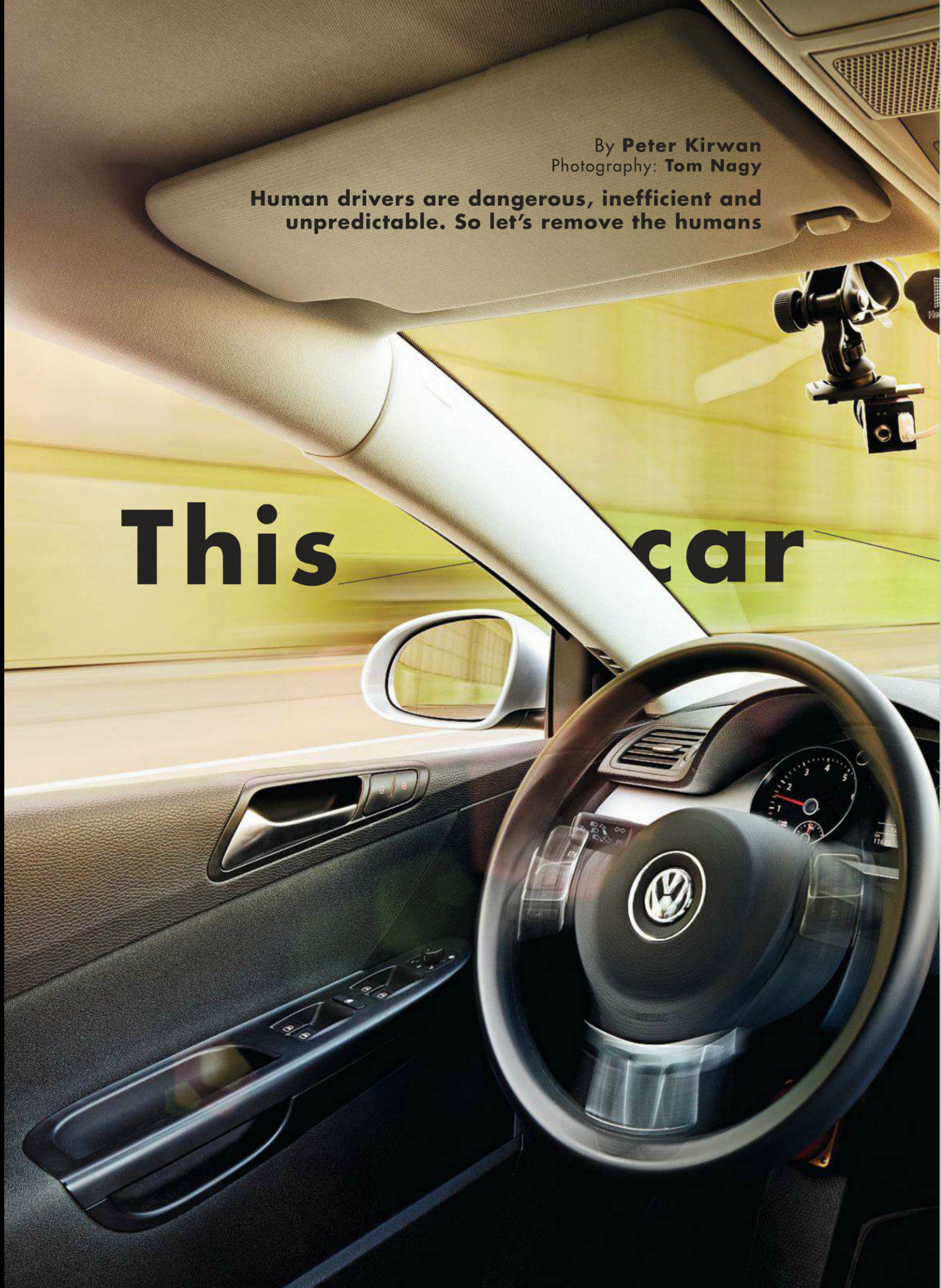
REDESIGNED SOCIALLY

Appsfire This service makes recommendations based on iPhone and Android apps that your friends are using. *appsfire.com*

Spotify Discover the music your friends are listening to via a live stream, or create and share collaborative playlists. *spotify.com*

Trippy Social travel, based on planning your trip around friends’ tips. A mobile app lets friends see your photos in real time. *trippy.com*

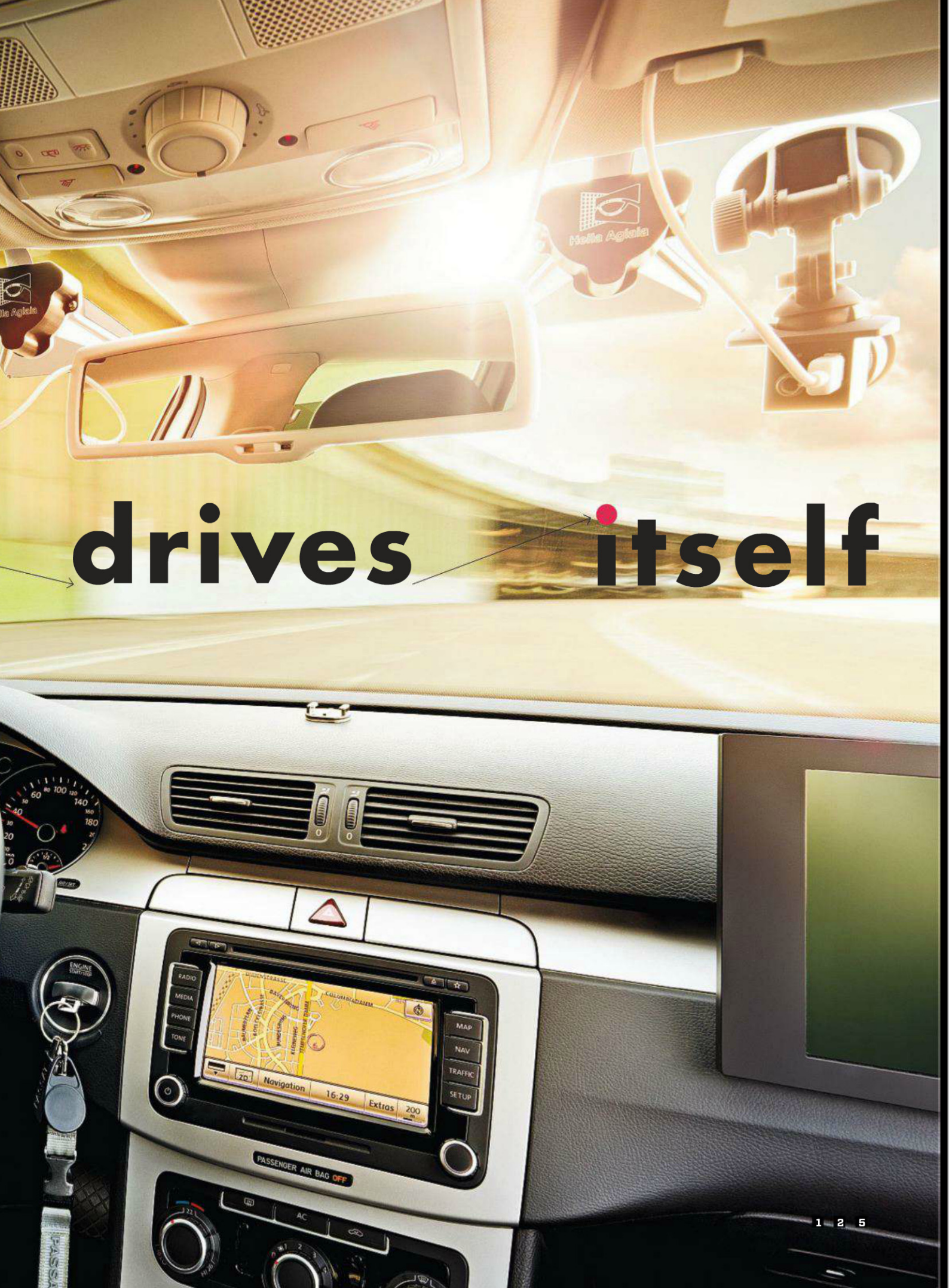
PHOTOGRAPHY: ALLSTAR



By **Peter Kirwan**
Photography: **Tom Nagy**

Human drivers are dangerous, inefficient and unpredictable. So let's remove the humans

This car



drives itself

At 8.20am on a Sunday morning, on a ten-lane carriageway that runs towards the Brandenburg Gate from west Berlin, hundreds of drivers are doing what comes naturally: mostly travelling above the speed limit of 55kph, drifting out of their lanes and fighting for space. This morning, however, one car will be doing its own thing. A heavily modified VW Passat, developed by a 20-strong team, will twice drive itself up and down the Kaiserdamm – a 29km journey – without human intervention.

There are four of us in the car, including Tinosch Ganjineh, a PhD student and research assistant, who sits in the driver's seat. Ganjineh is the safety driver: he will intervene at the slightest sign of trouble from the car's systems. Beside him sits researcher Miao Wang. On his lap is a quad-core notebook fed by an ethernet cable from the car's boot.

As we pull out into the traffic, Wang's voice interrupts the classical music on the car's sound system. "Engage," he says. Ganjineh presses a button and the car's autonomous systems take over. Ganjineh is mostly silent. When he speaks, it's in the low, flat, tones of someone intensely focused. "I have to watch the traffic closely," he says. "When something goes wrong I can press the button to take control, or simply touch the steering wheel or one of the pedals. When you hear a beep, I have control."

The prototype, named *Made in Germany* (MiG) on an old army lane at Tempelhof, the former airport in Berlin, which is now hired out to companies for vehicle testing

Our ride is more fitful than with a human driver. Twice during the 13-minute journey down the Kaiserdamm, Ganjineh's hands hover millimetres from the steering wheel. And it's tense: first a bus, then a lorry, start moving out of adjoining lanes, veering towards us. On both occasions, the car pulls sharply to the left, but then reverts to its original trajectory as the human drivers correct their course. Wang warns Ganjineh each time the car seems likely to make a decision. The verbal feedback loop, explains Raúl Rojas, professor of artificial intelligence at the Free University of Berlin and the leader of the project, is designed to reduce the stress experienced by the safety driver. "Watching the steering wheel moving by itself is a little uncomfortable," Rojas says. "You wonder if it's going to be OK."

On his notebook screen, Wang is monitoring the car's vital signs and a 3D representation of the outside world. A green line carves out the car's projected route. Obstacles such as the back of a bus are outlined in red. On the road, a woman on a bicycle comes into view. She is drifting across the lanes, into the traffic, carrying a child in a rear baby seat. Back on Wang's screen, the swarming lines have resolved into a solid red outline. The car has noticed another, more vulnerable, road user approaching. The car passes safely and the image disappears from the screen.

The Passat is the result of a €2.3 million (£2 million) investment by the German Federal Ministry of Education and Research. One of a handful of autonomous-driving projects in Europe and the US, Rojas's project has the potential to transform our relationship with that crowning achievement of 20th-century capitalism: the motorcar.

Self-driving cars are no longer science-fiction fantasy. The technology is mostly proven. And, as Jaron Lanier, the San Francisco-based computer scientist who has written extensively on the interface between the virtual and physical worlds, puts it: "If you get in a driverless car, you are less likely to die and more likely to get where you want to go faster. You'll also do less damage to the environment." As a result, pushed by a need to unclog our cities, reduce pollution and save lives, government agencies around the world have started to think seriously about a future in which robotic precision replaces flawed human driving skills on our roads.

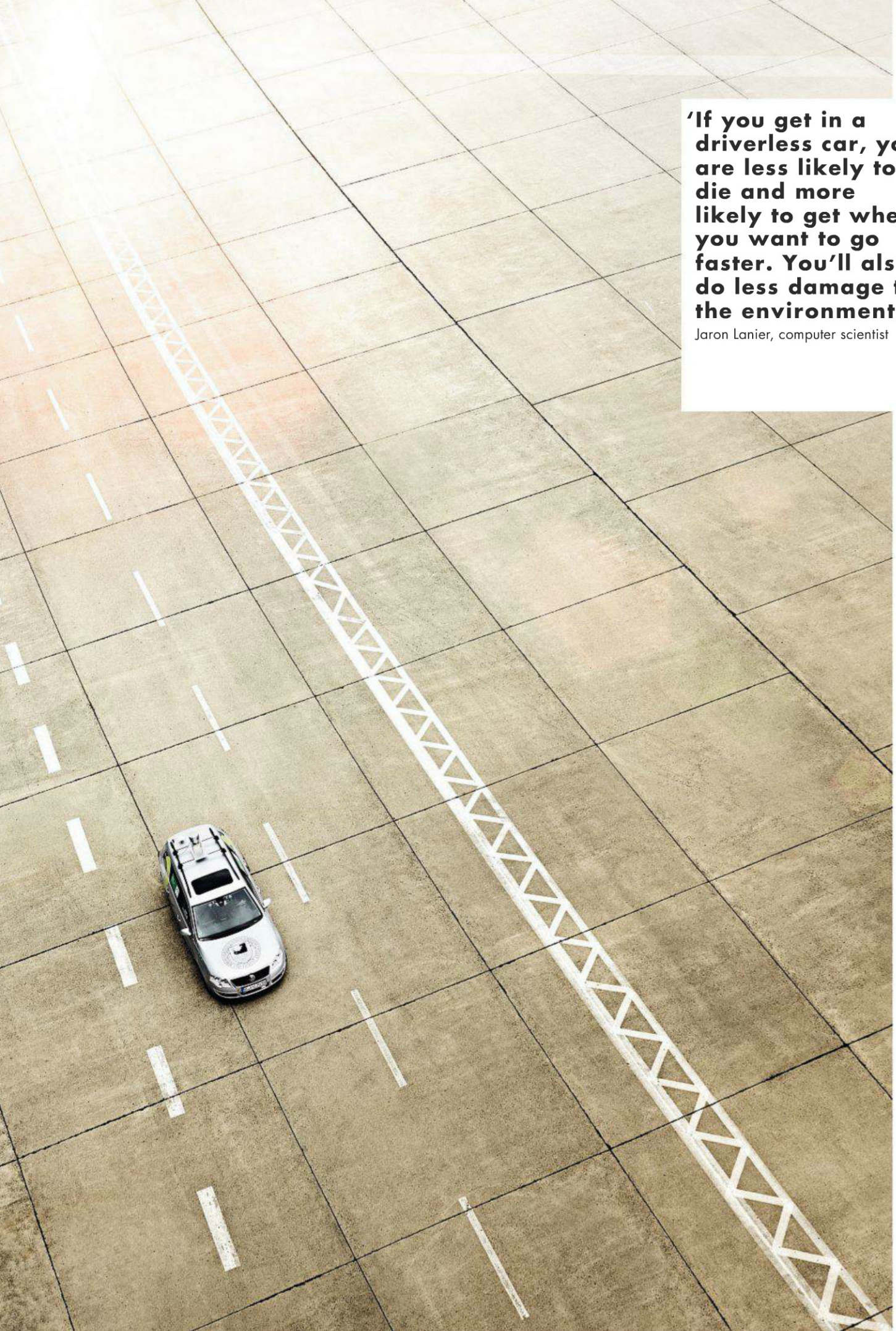
After the test drive, Rojas and Ganjineh offer a tour of the car's workings. It starts with an array of yellow and blue plugs in the boot. The car's software sends its instructions into this drive-by-wire gateway, ordering it to adjust its speed, or change lanes. Before it can decide what to do, the car needs to analyse data harvested from outside. Some of that data comes from six sensors on the car's sides. On top of the vehicle is a revolving scanner equipped with 64 laser beams that assimilate 1.3 million data points every second. "It's highly accurate," says Ganjineh. "It gives you a really good picture of the car's surroundings, including pedestrians, animals and small vehicles."

Behind the windscreen, a mono camera detects road markings, allowing the car to centre itself in its lane. Two colour cameras identify traffic lights, sending the appropriate stop or go message to the car's software platform. On the roof sits a €90,000 GPS receiver. The final piece of kit is an electronic route map on Wang's notebook.

Expensive as it may be, this hardware isn't revolutionary. Instead, it's the data-interpreting software – written by Rojas's team – that gives this car the ability to "see" a cyclist. The team programs the car to respond to this data. And, says Ganjineh, one thing matters more than most: "Professor Rojas always says my grandma should be able to drink a cup of coffee on the back seat."

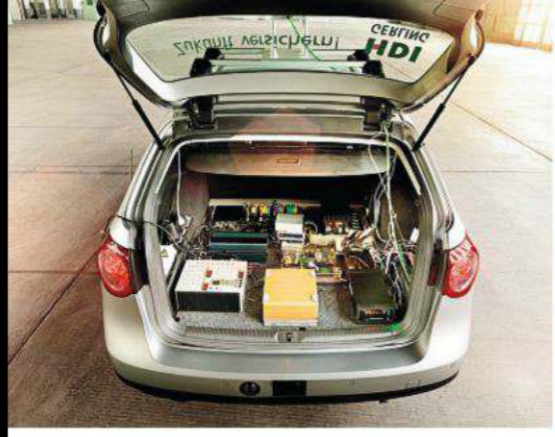
When Google's self-driving cars started attracting attention in September 2010, you could have been forgiven for thinking that the visionaries from Mountain View had invented autonomous driving. Not so. Research into self-driving cars has a lengthy pedigree in the US and Europe. Yet the story of how Google became a big player in the small world of autonomous driving certainly testifies to the freewheeling commercial imagination of Larry Page, Google's cofounder and chief executive.

In 2007, Page visited the Stanford University offices of German academic Sebastian Thrun. The youngest-ever director of the Stanford Artificial Intelligence Laboratory (Sail), Thrun had led Stanford's autonomous driving team to victory at the second DARPA Grand Challenge two years earlier. Page had been present as the team's heavily modified VW Touareg beat 22 other vehicles to complete the 212km race across the Mojave Desert in six hours and 53 minutes. By 2007, Google was rolling out Street View



'If you get in a driverless car, you are less likely to die and more likely to get where you want to go faster. You'll also do less damage to the environment'

Jaron Lanier, computer scientist



in the US. At their meeting that year, according to one source, Page and Thrun spoke for an hour about the future of cars and mapping. Google agreed to fund Thrun's research. Thrun, in turn, would work on Street View. The way was clear for Google to create its own driverless car.

In September 2010, Google went public with its efforts. The following June, Nevada became the first US state to allow autonomous vehicles on public roads. Recently, however, Page told investors to discount media speculation about "the latest crazy thing that Google did". "We are not betting the farm on a lot of those things," he added. Google's self-driving cars are tiny part of the company's R&D budget – the team has only recently exceeded 15 staff.

Rojas believes that Google is intrigued by the possibility of vehicles forming an intelligent swarm. A spokesperson says that "how to get the right information to the cars at the right time" is a major preoccupation. Google sees its data centres as the key. Processing what a spokesperson calls "the enormous amounts of information gathered by these cars when mapping terrain" is a major exercise.

Mapping isn't unlike search. Destinations are analogous to the web pages that Google indexes and identifies in response to user queries. In theory at least, there's no reason why self-driving cars equipped with Google's maps can't generate income in a similar way to search, a business that generates tens of billions of dollars each year. Invited by WIRED to comment on its plans, Google simply responded that: "We are a technology company, and as such our executives are always interested in cutting-edge ideas."

In his office the next morning, Rojas acknowledges that there is big money to be made. He says that the German Ministry of Education and Research wants him to produce "patents or startups or licensed technology". Rojas wants to secure further government funding for a startup. The team is building software to help Berlin's refuse trucks manoeuvre more safely. A company that makes $3m (£1.8m) supertrucks for opencast mines is interested. Aircraft could taxi more safely if they were equipped with $10,000-worth of sensors, says Rojas. "It's a sensible investment," he adds. "It would be easy to automate an airport."

Ultimately, however, the AutoNOMOS Project aims to make mass-produced self-driving cars a reality by slashing their cost. To do this, says Rojas, the industry will need plug-and-play AI systems. There remain many technical problems. Traffic lights and signs pose challenges. "Bright sunlight can saturate the camera image and video sensors need to improve," says Rojas. Understanding pedestrians' intentions isn't easy. "When you are driving and you see someone, you can interpret their posture. If a pedestrian is smoking, for example, he is probably not going to cross the street immediately." Computers find this kind of interpretation tricky.

Research into autonomous driving, Rojas says, is dominated by a dozen or so universities in Europe and the US, where trials are under way. In this world, simultaneous localisation and mapping (Slam) has emerged as the standard approach. In this respect, Rojas's project is very similar to the Google scheme. "We use the same kind of sensors," says Rojas, "the same kind of algorithmic approach, as well as maps and GPS."

When Rojas's car pilots itself down the Kaiserdamm, GPS provides its co-ordinates. The car then locates itself on the map, which also tells it where hazards such as traffic lights are located. "We also need to know the number of lanes, and which of them are open to traffic," says Rojas. "So we take a map of the city and we enrich it, we add our own annotations." In Google's case, this approach is augmented by what Professor Jürgen Schmidhuber of the Switzerland-based Dalle Molle Institute for Artificial Intelligence calls "the massive brute-force approach of Street View".

But if Slam represents the mainstream, it's not universally loved. A former Nasa employee called Ernst Dickmanns pioneered a rival method in the 80s that relies heavily upon interpreting the output from video sensors in real time. In 1995, Dickmanns rigged up a Mercedes that drove itself at up to 175kph along 1,758km of motorway between Germany and Denmark. Fifteen years before Google, Dickmanns' Mercedes achieved it without GPS or maps.

Today, Dickmanns' heir, Joe Wuensche, persists with the same approach. Talking by phone from his office in Munich, Wuensche points to the obvious weaknesses of GPS. The low-strength satellite signals on which it relies are jammable, courtesy

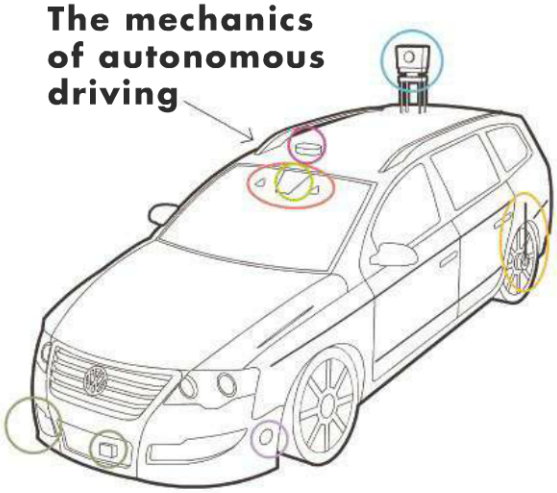
Pushed by a need to unclog cities and save lives, governments have started to think about a future where robotic precision replaces flawed human driving skills

Above: Self-driving kit in the car's boot; *Right*: AutoNOMOS team Fabian Wiesel, Patrick Vogel, Raúl Rojas and Tinosch Ganjineh

of £20 hardware devices readily available on eBay. "And to use GPS you need maps that are very accurate," he adds. "If you have road construction going on, no one is going to tell you that until they pop up on your way to work." Google's approach, Wuensche says, is "typical of computer scientists" who like to "deploy massive computing power".

Not only is the Munich approach lightweight, but it also mimics nature. "How many creatures on Earth rely on ultrasonic distance measurement?" asks Wuensche. "Bats and dolphins: that's about it. In nature, vision has won. There must be a reason for that. Building self-driving cars that rely upon vision is harder and it will take longer," he says. "But it will be the cheaper and better solution in the long term."

The mechanics of autonomous driving



- **VELODYNE** Laser scanner for 360° obstacle detection in parking areas
- **GPS/IMU** The high-precision GPS unit ensures perfect positioning
- **CAMERA** Perceives traffic lights and lane markings
- **STEREO CAMERAS** 3D images can be created from twin cameras
- **ODOMETER** Measures velocity to support the positioning system
- **TRW RADAR** Monitors the side regions during passing manoeuvres
- **SMS RADAR** Short-range radar to gauge the velocity of other vehicles
- **IBEO LUX** Data merged from all six sensors allows 360° obstacle detection

ILLUSTRATION: SCOTT ASHCROFT

According to the World Health Organisation, 1.2m people die each year in car accidents globally. In 2009, 2,337 deaths in the UK were a result of road accidents. The deaths that resulted from accidental drowning (205), fire (279), assault (318) and alcohol poisoning (179) is tiny by comparison. Road accidents are the leading cause of death among people aged between 16 and 24. Google's Thrun believes that the vast majority of road-based fatalities are caused by human error and could be prevented by machines.

Humans aren't just dangerous when they get behind the wheel; they're also inefficient. Today, according to research from Texas A&M University, the average American commuter spends 34 hours a week stuck in traffic jams. Congestion, it suggests, costs the US economy $100bn a year, or roughly $750 per commuter. So clearly, self-driving cars could do a lot to change this. Rojas foresees commuters hopping into an autonomous car that has driven itself to their front door. The car picks up other passengers on the way to the nearest suburban rail station, and from there commuters travel into the city. Rojas has forecast the potential impact using a digital model of Berlin's transport system. "You could move the entire city with one-tenth of the cars that you have now," he says.

Further, sales of autonomous vehicles to the developing world, whose conurbations are increasingly clogged with traffic, could provide a billion-dollar revenue stream, Rojas says. "I think it will work out just fine for the car industry," he says, smiling.

In the meantime, other projects are winning funding. In France, for example, a small VC-backed company called Induct is touting the Cybergo, a self-driving electric vehicle designed for what the company's founder Pierre Lefevre calls "the last kilometres that lie between public transport and your destination in pedestrianised city centres". This suggests that Rojas's vision may yet play out in much the same way as London's "Boris Bikes", or the recently launched €200m electric-car-sharing scheme in Paris.

The Frankfurt Motor Show is a temple to what Volkswagen used to call *Fahrvergnügen* ("driving enjoyment"). The clubby, male atmosphere at the city's hotels at night disguises a radical shift that is transforming

the car industry. By one estimate, electronics and software now account for 80 per cent of innovation in the industry. Today, the average luxury car contains up to 100 microprocessors; software and electronics account for 35 to 40 per cent of its cost. This proportion will rise as more hybrid and electric vehicles become available. The Volt, a hybrid launched by Chevrolet last year, contains ten million lines of code. By comparison, a Lockheed Martin F-35 fighter relies upon 5.7 million lines of code to fly at speeds of more than 1,900kph. Wuensche suggests that most of the vehicles launched at Frankfurt this year qualify as robots.

When the history of autonomous driving is written, its authors will probably choose the introduction of adaptive cruise control (ACC) a decade ago as their starting point. Cars equipped with ACC can detect vehicles ahead of them. When this happens, an ACC-equipped car slows down and maintains a safe distance, only returning to its original speed when the road ahead is clear.

Each year, automation pushes a little further. If an inattentive driver gets behind the wheel of Volvo's current-model S60, the car can detect an oncoming pedestrian and apply braking power of up to 1G – enough to bring a vehicle travelling at 35kph to a halt in one second. Peter Miller, from UK-based automotive engineering consultancy Ricardo, says this is a turning point. "We're now going beyond systems that react at the last minute to reduce the damage in a collision," he says.

If an inattentive driver gets behind the wheel of Volvo's S60, the car can detect a pedestrian and apply braking power of up to 1G – enough to bring a car travelling at 35kph to a halt in one second

Technology such as this has begun filtering into the mass market. Ford's latest Focus keeps inside lane markings, recognises road signs and automatically brakes at less than 32kph if the car in front stops unexpectedly. Such innovations are being boosted by a Moores Law-like fall in the cost of radar sensors. "The downward price curve on radar sensors is very aggressive," says Mike Thoeny, director of electronic controls engineering at US component supplier Delphi. "Our prices will fall by another 50 per cent by 2013."

Echoing Joe Wuensche, Miller says: "You could run most of these safety systems without radar. The price of vision sensors has fallen more rapidly in price than radar. We have the huge demand for these sensors in smartphones to thank for that."

At Frankfurt, there's evidence of ambivalence. Some executives talk about technology "entering" the vehicles, as if an alien invader. Is there a split in the car industry? Not quite, says Wuensche. "There are people who look ahead and openly speak out, and there are others who are still afraid of speaking out." Jürgen Leohold, director of research at VW Group, is one of the few senior industry figures willing openly to discuss autonomous driving. "We will see further innovation," he says. "On an autobahn, you often follow a crew of cars and it's really boring," he says. "The next step is to automate the car in this kind of situation."

Beyond that, there is VW's Temporary Auto Pilot, a semi-automated driving platform unveiled by Leohold last summer, which he expects to take "some years" to reach the market. "In the long run we will have an autopilot in the car," he says.

Back in Berlin, Rojas thinks he knows how to overcome the weakness of Slam. "What Google and other companies would like to have," he says, "is a kind of social network on our streets. So when lanes on the highway are suddenly closed, for example, your car already knows what is coming up." Rojas is anticipating the arrival of the internet of things – whereby physical objects are tracked on the network – on our streets. To make this happen, autonomous cars will need to communicate with one another and with traffic lights, road signs and transceivers on the roadside.

Alan Winfield of the University of the West of England foresees vehicles behaving like

Above left: Tinosch Ganjineh uses an iPad to control the car and observe the sensors' data. *Left*: the outside world as "seen" by the car. *Above*: the roof-mounted scanner provides 360° vision

a "biological swarm, a distributed autonomous system". Cars will drive themselves in the same way that starlings fly in a murmuration. To carve the optimal route, Winfield says, each connected car "will only need to interact with the ones next to it, or nearby".

"Within this decade, we will see this technology rolled out more or less worldwide," says Leohold. Within two years, he says the penetration rate may be five to ten per cent.

On a test track outside Gothenburg, Stefan Solyom, a technical specialist at Volvo, is working to realise these benefits. For the past few years, his team has been collaborating with researchers from the UK, Spain and Germany on ways of allowing lorries to travel in self-organising convoys.

Using radar, cameras and the Wi-Fi standard 802.11p for real-time communication between vehicles, Solyom's lorries mimic the speed and trajectory of the convoy's lead vehicle. "The other drivers can have breakfast or watch a movie," Solyom says, only half-joking. Drivers travelling at 90kph typically like to remain at least one second – or up to six vehicle lengths – behind the vehicle in front. In Solyom's convoys, lorries travel much closer: as little as half a vehicle length from one another. As a result, each lorry travels in its predecessor's slipstream. "You can cut fuel consumption by 50 per cent and reduce congestion," says Solyom.

Fixating on such benefits is easy. But there will be side effects. In San Francisco, Jaron Lanier predicts millions of job losses. "Driving a lorry or a taxi is one of the basic ways of earning a living around the world," he says. "This is non-trivial."

Lanier can see new business models emerging. To understand how this might happen, he recommends thinking about Rojas's scenario: a road on which three lanes unexpectedly narrow to two because of roadworks. "There's always a point at which there's no choice but for human drivers to get in line," says Lanier. "But every time two cars meet, there's a tiny time loss. Cumulatively, the results are insane. We all pay for this." The solution involves intelligently networked cars organising themselves – because humans, it seems, can't. "The cars will save time by merging as far back down the freeway as necessary to maintain speed all the way through," Lanier adds.

Some road users may decide to "pay more money to end up further up the queue", says Lanier. Among the results would be the birth of what he describes as "a little stock market, or a bidding market" for levels of access and rights amid the swarm. "You will have brokers and analysts and a whole little world of people organising this. There will be people on top of the algorithms, making sure it all works because they'll have liability if it doesn't. This will create jobs."

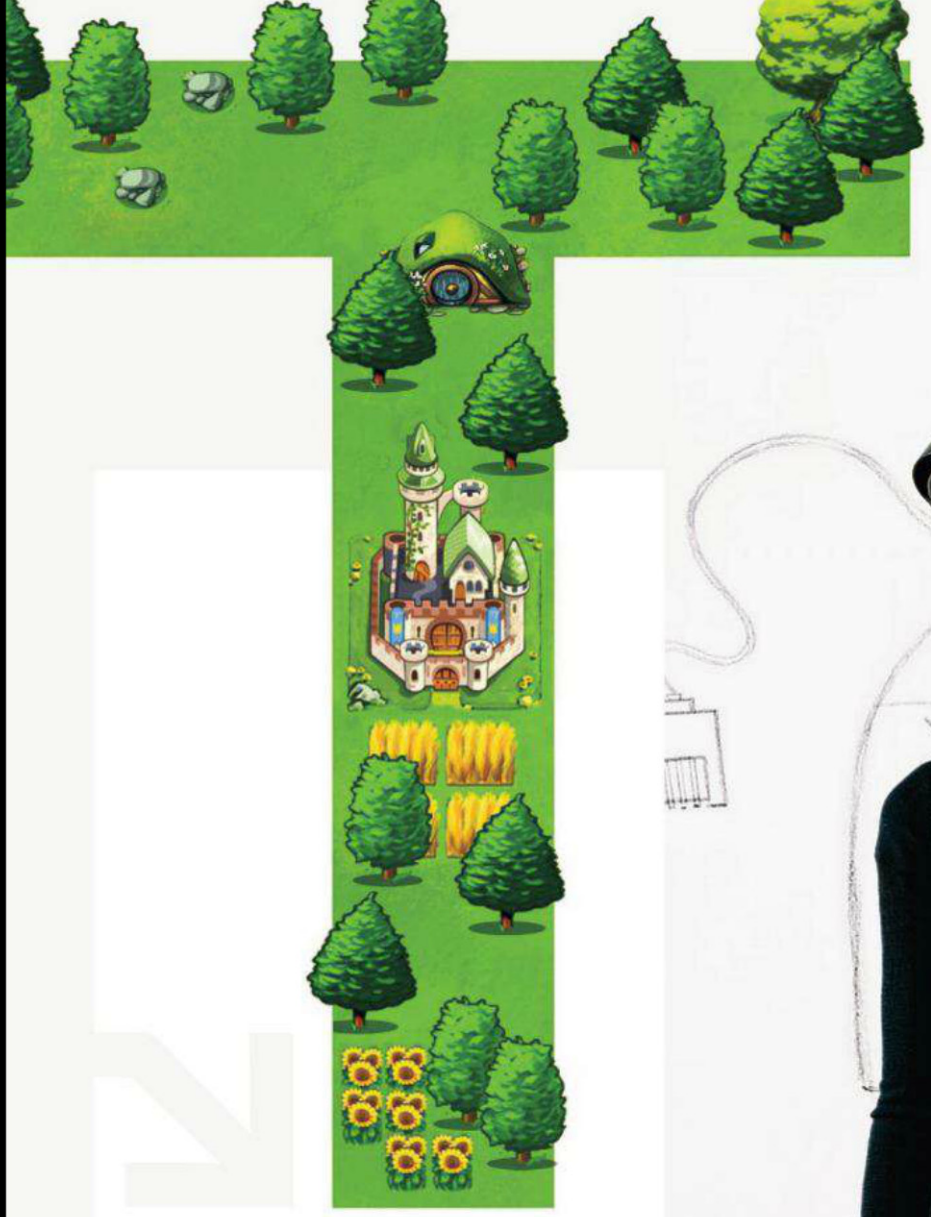
For more than a century, our relationship with the internal combustion engine has proceeded along the lines of a Faustian pact. We've gained much, but the costs can be measured in millions of deaths, endemic gridlock and a degraded environment. Autonomous driving could help to reset this pact. Most of the challenges aren't technical; they're political, economic, legal and social. The question is whether we're ready for the machines to take control.

Peter Kirwan wrote about 4G in 09.11

TEST.
TEST.
TEST.

How *Magic Land* publisher wooga turned the games business into a science

By **Tom Cheshire** Photography: **Timmo Schreiber**

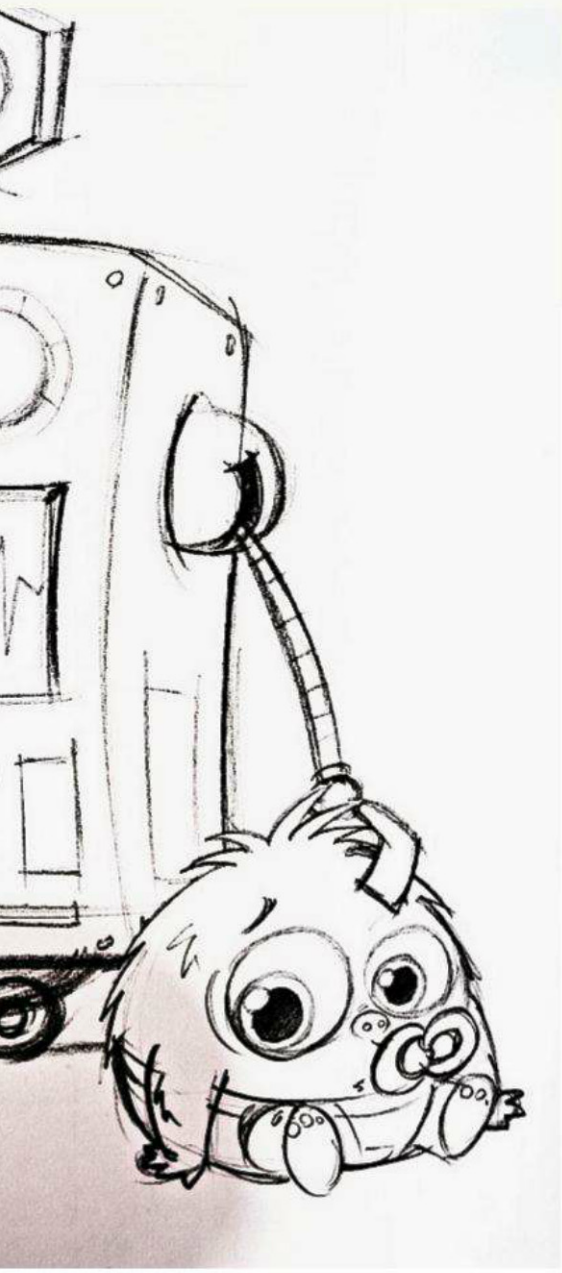


he first task for Jens Begemann each morning is to check the numbers. On his iPhone, the wooga founder reads an email sent at 4.04am. It shows charts for *Magic Land*, the Berlin-based company's newest release: the number of users active in the last 24 hours; the number of new users and bookings; the proportion of unique users who came from Facebook requests or from links on friends' feeds; how many batches of 15,000 Gold or 545 Diamonds, the game's currency, were sold. Begemann can see how many made it to the second stage, "Configurations loaded"; how many completed the tutorial; and where those who didn't dropped off. He checks the geography of players, broken down into new users, one-day retention and bookings per daily active user.

In total, Begemann studies 128 data points. He does the same for the six other games that wooga has released. "Some differences are obvious, like Wednesdays are better than Thursdays," Begemann says. "But if I still can't make sense of the reports, I forward the question to the respective product lead of the game." Then he puts away his phone, takes his two-year-old son to kindergarten and walks to wooga's Prenzlauer Berg offices in east Berlin.

Wooga is a new type of game developer, one that emphasises metrics over creativity. Its core discipline is A/B or split testing, in which new features are introduced to a selection of users, and their reactions measured. Features remain only if users engage with them. If they don't respond, wooga tries new features until they do. Each wooga title is updated weekly; the initial release is just another stage in development. "After launch we become very metrics-driven," says Begemann. "During the first two weeks of *Brain Buddies* [wooga's first game], we did four or five A/B tests. It was very fast – almost daily iterations."

The result is a rigorous process that practically automates the creation of a social game, and maximises each title's chance of success. "We A/B test everything, we optimise everything," says Stephanie Kaiser, a lead game designer. "In the product department, it's very simple," says Thorbjörn Warin, a former employee. "They have all of their KPIs [key performance indicators] and metrics. It's really, 'This week, we focus on nothing but retention, let's identify ten activities that can increase that.' In the first 60 seconds of *Monster World*, there are 13 to 15 tracking points. For a new user, when they start playing, every three or four seconds, Stephanie and Jens can see what is happening...



Left: lead game designer Stephanie Kaiser in front of sketches for *Monster World*

Usually something has to be improved, and that's when creativity comes in." Wooga's users don't just play a game; they design it.

This paint-by-metrics approach has proved successful. Founded in 2009, wooga is now the third most popular games developer on Facebook (it was briefly number two, ahead of EA, before the launch of *The Sims Social*). Wooga games have 32 million active monthly users from 231 countries; seven million of these play a wooga game every day. The majority of its games have more than a million users who play daily; only Zynga and EA have managed the same feat. In the last year, the number of wooga users grew by 300 per cent.

In 2008, Begemann didn't have a company, or even an idea, nor did he know what a social game was. But he did know that a games studio should be no different from any other web service, and that data comes before art.

At 10am on a Tuesday morning in August, 35 people are gathered in the wooga offices. Drussila Hollanda, the new lead on *Monster World*, a Facebook game like *FarmVille* but with beasts instead of humans, is holding her first weekly meeting. She is explaining the game's latest updates: the introduction of a long-worked-on windmill feature, how the game is faring on Google+, scheduled A/B tests of different loading screens and currencies, and the number of daily active users (DAU) over the week. Wooga holds six weekly meetings, one per game. Begemann asks if the windmill was A/B tested, or introduced wholesale. Hollanda replies that all users have the new feature. Begemann frowns: "We could also have A/B tested that. But OK. That's fine."

Behind his desk is a sign: "Be fast and be bold. Only do features that increase DAU monetisation." He's expecting his second child within a fortnight. A week earlier, he launched *Magic Land*, which already has about 800,000 users. Loud and large, he leans forward and explains how a company he founded two years ago is taking on giants.

Begemann grew up in Barkhausen, a tiny village in west Germany. His parents were farmers and also taught in the local school. When Begemann was ten, they gave him his first computer, an Apple II, and he began coding. After studying business at the University of Applied Sciences in Berlin, he wanted to join a startup. In 2001 he joined Jamba, known as Jamster in the UK. "The vision was to be the Yahoo! for mobile," says Begemann. "It didn't work out." Jamster sold premium-rate SMS content, ringtones and games. It earned a reputation for misleading customers with its ads and contracts, as well as for its low-rent content. "Remember the Crazy Frog?" he says. "I'm sorry for that. Very, very sorry."

In mid-2008 he left the company, determined to be an entrepreneur, but unsure what sort. He travelled to TechCrunch50, a tech conference in San Francisco, in search of an idea and returned with a vision. "The games industry has become perfect at creating games for a niche," he says. "Maybe ten per cent of the population. My dream was creating a company that would specialise in games for the rest, for everybody." And Facebook now offered the perfect platform for reaching

Wooga doesn't make money from advertising, but by selling virtual goods. Using Begemann's statements and public information, WIRED estimates annual revenue, after Facebook's 30 per cent, at between £12.9 million and £20 million. Last summer, the company raised $24 million (£14.8m) from Highland Partners (who invested in Digg), taking its total backing to $32 million. At the time, Roberto Bonanzinga, a partner at Balderton Capital and one of wooga's first investors, said of Begemann: "He's obsessed by consumer feedback. These guys release a new version of each game every week, based on testing and feedback. It's a huge testing lab."

WOOGA'S USERS DON'T JUST PLAY A GAME, THEY DESIGN IT

everybody. Begemann also saw that distributing games through Facebook changed the nature of publishing. Games no longer needed boxes to ship. They didn't even need to be finished before release, and in fact could incorporate live user feedback as part of a continuous design process: each wooga title is released as a "minimum game", then updated every week. Begemann combined this insight with another he learned in the US: that some of the most successful web companies conduct split testing.

On May 20, 1747, James Lind, a surgeon on the *HMS Salisbury*, carried out one of the first recorded A/B tests. He chose 12 sailors suffering from scurvy and made sure "their cases were as similar as I could have them". Lind divided them into six pairs and gave each different supplements to their usual diet. "The consequence," he wrote, "was that the most sudden and visible good effects were perceived from the use of oranges and lemons; one of those who had taken them, being at the end of six days fit for duty."

A/B tests are, in effect, designed experiments and they date back to Galileo. All that has changed is scale: they can be conducted on millions of users, in real time. Jeff Bezos, who founded Amazon in 1995, pioneered split testing on the web, proclaiming at a staff boot camp in 1997: "At Amazon, we will have a culture of metrics!" James Marcus, then working at the company, later wrote a book, *Amazonia*, about his time there: "Gone were the fuzzy approximations of focus groups, the anecdotal fudging and smoke-blowing from the marketing department. A company like Amazon could (and did) record every move a visitor made, every last click and twitch of the mouse."

FACEBOOK CHANGED THE NATURE OF GAMES PUBLISHING

The companies that took this approach tended to be retailers and software providers. Begemann realised that A/B and usability testing could be applied to more creative sectors too, and set out to make them part of wooga's identity. "We built it into our infrastructure from day one," he says. Bonanzinga says this is what convinced him to back wooga. "I had already decided I wasn't going to do an investment in social gaming. But they had a very specific view of *how* they wanted to do it," he says.

Coming up with the game ideas would be the easiest part – wooga studied successful games. Begemann incorporated wooga in January 2009 with cofounder Philipp Moeser. Their first game was *Brain Buddies*. "The working title was *Brain Sports* – we wanted to take this success from the Nintendo DS to the web." In the 12 weeks before launch there were 12 user-test sessions for *Brain Buddies*. These "changed the game quite a bit", says Begemann. In July 2009, the game went live – and the real work began: intensive testing. The effect was dramatic: by November, *Brain Buddies* had six million daily active users. The same month, Balderton announced it would invest €5 million in the 25-person company.

Left: A metrics board in the office shows monthly and daily active users in real time. *Top right*: Kaiser (*front*) with Begemann (*rear*) and a graph of monthly active users

Wooga was set for success – but then Facebook changed the rules. Previously, users had been subjected to a tirade of notifications about social games, even if they themselves weren't playing them. This annoyed many, but made it easy to market the games. Facebook's changes curbed this virality. "Almost all companies suffered," says Begemann. "Our numbers went from six million monthly active users to three million by January." Developers had become used to fast, viral product launches: so far, Zynga has released 49 Facebook applications; EA has 45. These tactics wouldn't work any longer.

Another threat to Begemann's business was renewed consolidation in the market. In September 2009, Playdom, a rival firm, raised finance from Disney that valued it at $260 million. Two months later, in

November 2009, EA bought Playfish for $300 million. "Sitting in this office, my cofounder and I, with a few interns – we realised how small we were. We realised that, in this market, you need critical mass. That was my hypothesis in 2009, that cross-linking in games [whereby players of one wooga title are pointed towards new releases] would become super important. We had maybe one or two years to get into the top five. We changed our whole approach to games, focusing on engagement instead of virality."

Wooga's next game was *Bubble Island*. Released in February 2010, it was an immediate success; more than two million people still play it every day. *Brain Buddies* and *Bubble Island* had both been free-to-play and were not supported by advertising. Their purpose was simply to build a user base. But the next title, *Monster World*, was more ambitious. It would be the first wooga title to charge cash for virtual goods. It would be proof of concept for the entire business.

Begemann turned over the game to Kaiser, a former colleague from Jamba, who had never developed a game before. Kaiser took her inspiration from *Wurzelimperium*, a web browser game developed by Upjers that looks like an Excel spreadsheet in which players cultivate a garden. She would change the perspective to make it look more 3D, but keep the mechanics. Kaiser's team went through the now-standardised development process, performing usability tests even with paper prototypes. But while the game was in development, other farming games appeared: Zynga's *FarmVille* and Playfish's *Country Story*. The team changed direction and "decided to look into monsters".

onster World **launched in April 2010. But** it soon stalled, with only 300,000 daily active users by August (wooga considers one million users the minimum mark of success). "It was not growing virally and it was not a success at all," says Kaiser. The team focused on three topics: engagement, virality and monetisation, and went to work on the first. Kaiser began with the "user funnel"; she studied 38,863 users who began the game tutorial one week, to see where they dropped off. "A 1.3 per cent drop is unacceptable and the game is optimised accordingly," she says. When such a loss was identified, Kaiser's team would develop two solutions, put them both live as an A/B test, and find out which performed better. And so on across every part of the game. It worked. On November 16, *Monster World* reached a million daily active users. "What we learned was that you could really turn a game around post-launch," says Begemann. "It had always been my belief, but that's the first time we really proved it, by doing nothing else other than A/B testing, and of course being creative. Four months after launch, that's when some companies would have given up."

Left: A Buzzy from *Monster World* keeps guard over the staff bikes

With this larger user base established, wooga "switched on the monetisation". *Monster World* offers several ways for a user to pay to customise their game. But two-thirds of wooga's revenues come not from these adornments, which account for around only two per cent of total sales, but from the items that turbo-charge a player's progress in the game: magic wands, which harvest crops instantly (240 wands cost 480 Facebook credits, worth roughly £76), and "woo-goo", which produces several other items of value. These may sound whimsical, but "a feature has to be driven by metrics, it can't just be cool," says Kaiser.

Begemann says that fewer than five per cent of wooga's users spend real money – "a few euros, a few dollars, sometimes in the double digits". Its aim is to promote a deep engagement with the game. "It's our biggest monetisation driver," says Begemann. The revenue mainly comes from people who have been playing wooga's games for maybe six months.

The emphasis on engagement ahead of virality is paying off. Begemann contrasts wooga's deep approach with that of web portals offering flash games. "Their philosophy is creating lots of games, two a day, and then you play them for an hour and you're done. I wanted to create games that are easy to get into but are so difficult to master that you spend weeks and months playing them."

don't fucking want innovation," CEO Mark Pincus reportedly informed his staff at Zynga, according to an article in the *San Francisco Weekly*, in September 2010. "You're not smarter than your competitor. Just copy what they do and do it until you get their numbers."

It's difficult to patent a game idea or mechanic: certain formulae appeal to users and so repeat themselves, as in music or films. Some degree of copying is to be expected. "If you look at the history of the computer games industry, how many distinctive genres have been invented?" Begemann asks. "How many first-person shooters have come out? Of course we're inspired by existing ideas, but we always try to bring something new to it."

Over the last 30 years, the distinction between video games and art has been eroding. Recent titles such as *BioShock*, *Heavy Rain* and *LA Noire* aspire to a movie experience. The same could not be said of *FarmVille* or *Monster Land*. In the social era, bad games are making very good money. Developers of social games do not try to bring a compelling idea to life, then release it: they find a compelling market, then fit an idea to it. "We've moved in the gaming space from the age of artists to the age of mathematicians," Shervin Pishevar, MD at Menlo Ventures and founder of the Social Gaming Network, told a panel at GamesBeat 2011 in July. "I don't think Zynga is a gaming company, it's a business-intelligence company."

"Zynga and wooga and companies like that have no interest whatsoever in the outcome of the product," says Edward Castronova, author of *Exodus to the Virtual World*. "They have no prior vision of what they're making. All they want to do is provide an environment that people spend time in and click on and spend money on."

Such criticism is especially vociferous from traditional hardcore gamers. Begemann says they're not comparing like with like. "Social games are taking away [hardware] barriers and making everything accessible. Yes, if you're a gamer playing 50 hours a week, some of the games will not resonate with you, just as how hardcore games do not resonate with our target group." Nor does Begemann think the emphasis on metrics makes his company a business intelligence operation. "Wooga is heart plus brains. We have this creativeness and these analytics, and both are equally important."

Social games come with new rules. Traditional titles can broadly be divided into games of skill and games of chance. *Monster World* and *FarmVille* are games of labour: plant a seed and you will eventually grow a plant. And this appeals to the new type of gamer: the average wooga user is a 40-year-old woman who logs in eight times each day. "The mum with two kids and a job, she works really hard all day, then comes back home and takes care of the kids," says Mikołaj Jan Piskorski, an associate professor at Harvard Business School who studies social networks. "When the kids go to sleep, she's

completely knackered and wants to relax or talk to her friends, but it's too late to call. Playing the game with your friends is a low-cost way of keeping in touch."

Quality is improving. For many social gamers, *FarmVille* was the first video game they had ever played, but they're now more discerning. "Early on, [Facebook users] did put up with really bad games, because they hadn't seen them before," says Wilhelm Österberg, product manager at wooga. "That's how the platform is now maturing – from viral chaos to promoting the best games."

Making the best games represents a market opportunity for wooga, which lacks the scale of EA and Zynga. "If you're trying to compete with Zynga on the city concept or ville concept, you'll have a really hard time," says Piskorski. "But if you're developing a new way of engaging... I think it's quite conceivable that you might be able to replicate a lot of the success of Zynga."

CityVille reached 100 million monthly active users in only 43 days, but a month later it had lost four million. It's still the most popular game on Facebook, but now has around 75 million users. *FrontierVille*, a newer Zynga title, lost a million users in a week in September 2011, while *Magic Land* added 600,000, to take it to three million monthly active users. Wooga is preparing to release one game on Facebook per quarter in 2012; it currently has three as yet unnamed titles in production. This portfolio is giving wooga the critical mass that Begemann wants. Only five per cent of users of wooga's new games are acquired through advertising: the rest are introduced by existing players. Spending heavily on advertising, as Zynga does (Silicon Alley Insider reported that it spent $72 million on Facebook ads in 2009), means a lower average revenue per user; Zynga makes about $1.60 per unique user per quarter. In the second quarter of 2011, Zynga's profits fell from $14.4 million to $1.4 million – a drop of 90 per cent caused by development and marketing costs for two new titles.

The fight is moving to new battlegrounds. Wooga recently developed *Diamond Dash* for iOS, ported several of its games to Google+ and is building an HTML 5 version of *Magic Land*. It is also firmly targeting Europe. "In aggregate, Europe is bigger for us than the US – much bigger," says Begemann. "And there are markets which are growing fast at the moment. We're testing how much better engagement is if we localise." From the beginning, wooga localised its content. Its games are now available in seven languages, with variable success in each region (for example, wooga says that France monetises four times better than Spain.)

Begemann aims to have grown his team to more than 200 employees by the middle of 2012. "Our big, big vision is to be one of the leading companies by 2020. We know that's a little bit crazy, but we believe it's possible. That would be billions of dollars per year. If we continue to grow over the next nine years like we have over the last two, then that's a realistic goal." Speculative? Wooga doesn't take punts: it tests everything.

By lunchtime after the *Monster World* meeting, the windmill feature is undergoing A/B testing, as per Begemann's query. A week later, Drussila Hollanda sends an email: "The initial A/B test showed that there's a 75 per cent chance that woogoo consumption is lower and didn't affect DAU. The feature will remain on for only 50 per cent of the players as we'll investigate it further and tweak it for a new test." W

Tom Cheshire is associate editor of WIRED. *He wrote about Recorded Future in 12.11*

THE FACEBOOK GAMES ECONOMY

THE SOCIAL GAMER

35% Internet users in the UK who play social games

7.7m Hours spent on social games every day in the UK

55% Proportion of UK social gamers who are female

THE PLATFORM

800 Millions of users who currently have Facebook accounts

50% Percentage of Facebook logins to play games

7 Games firms that each have over 10m monthly users

IN-APP PURCHASES

$2bn Amount of virtual goods traded in 2011 in the US alone

$5bn Estimated worth of global social-gaming market by 2015

£210m Amount predicted to be spent by social gamers in UK in 2011

VALUATIONS/ ACQUISITIONS

$400m Reported amount that EA paid to acquire Playfish

$763m The amount that Disney paid to acquire Playdom

$11.5bn Zynga's valuation of its market capitalisation, March 2011

SOCIAL GAMES ARE A NEW TYPE OF GAME – THEY HAVE NEW RULES

FOR STATISTICS SOURCES, PLEASE SEE COLOPHON ON PAGE 162

CEO of the internet

Photography: Nigel Parry

JEFF BEZOS ON

- books
- movies
- music
- the new Kindle
- cloud computing
- disruption
- IT infrastructure
- social media
- and (WHEW!) sending people into space

by Steven Levy

GO

"What I'm about to show you," Jeff Bezos says, "is the culmination of the many things we've been doing for 15 years."

The CEO of Amazon.com, in regulation blue Oxford shirt and jeans, is in a conference room at his company's spiffy new headquarters just north of downtown Seattle. In a week's time, on September 28, he will introduce a new line of Kindles to the world. He has already shown WIRED two – one with a touchscreen, the other costing just $79 (£50) – but that's not what's truly exciting him. It is a third, the long-awaited Amazon tablet, the Kindle Fire, that's his company's most ambitious leap into the hearts, minds and wallets of millions of consumers.

Bezos runs through the features that will soon set the tech world ablaze – the $199 price tag, the easy-to-hold size, the seamless access to Amazon's rich and growing collection of digital media. When the Fire is introduced, analysts will declare it the strongest competitor yet to the iPad. Yet the Fire is not just a rival device, but something essentially different. The iPad is the flagship of the post-PC era – in which the desktop is replaced by lean, portable, gesture-driven tablets. The Fire is an emblem of a post-web world, in which our devices are simply a means for us to connect directly with the goodies in someone's data centre.

Although users of the iPad and the Fire will engage in many of the same activities – watching films, playing *Angry Birds* – the philosophy behind the two tablets could not be more different. Apple is fundamentally a hardware company – 91 per cent of its worldwide revenue comes from sales of its machines, compared to six per cent from iTunes. The iPad's design, marketing and product launches all emphasise the special character of the device itself, which the company views as a successor to the PC – complete with video-chat capabilities and word-processing software. Amazon is a content-focused company – almost half its revenue comes from sales of media such as books, music, TV shows and films – and the budget-priced Fire is designed to be primarily a passport to the large amount of that content that's available digitally. The device comes loaded with customers' Amazon account info, and anyone in the US who signs up for Amazon Prime, the $79-a-year shipping service, can access more than 12,000 films and TV shows on the Fire at no extra charge (no UK pricing plans have been revealed as yet).

Bezos doesn't consider the Fire a device, calling it a "media service". He sees it as an advanced mobile portal to Amazon's cloud. That's how Amazon has always treated Kindles: new models simply offer improved ways of buying and reading the content. Replacing the hardware is no more complicated or emotionally involved than changing a battery.

The iPad emphasises downloads: customers who buy music, TV shows or movies via iTunes must download to their machine. (Even users of its new iCloud service must download their music to listen to it – at least for now.) This keeps iPads tethered to the paradigm of local storage, putting a premium on machines with more memory (which cost hundreds more). Amazon, by contrast, emphasises streaming. Fire users can store 20GB of music for free on the company's servers (or an unlimited amount bought from Amazon). They can stream it freely, along with more than 100,000 videos. That's probably why the Fire's hard drive is 8GB, half the size of the smallest iPad's.

The glory of the iPad, as well as the iPhone, is its operating system; Apple's proprietary iOS is one of the main selling points, and the company regularly adds new features – such as Siri, the voice-activated PA. The Fire is built on Google's Android OS, but a simplified version of it. (Fire users will have access to a heavily curated subset of the 250,000 Android apps.) Bezos seems to believe that people shouldn't care about what their OS can do and should just be able to stream the

damn film. It's a similar philosophy to Google's Chrome OS, but tied to a proprietary piece of hardware and Amazon's media services.

The Fire does have one compelling new piece of software: a faster browser, called Silk. But even that's a servant of Amazon's cloud vision. Over the past eight years, the company has capitalised on its data-centre expertise to build a vast cloud-computing platform, which hosts web operations for some of the world's largest internet companies – even competitors such as Netflix. The Silk browser harnesses those cloud servers to do much of the processing. "We call it a split browser, because it's half in the cloud and half on the Fire," Bezos says. It's a hack that aims to make web pages download much faster. But it also has grand ramifications: it points to an era in which the device is so secondary that even computation takes place in the cloud.

The release of the Fire shows how forward-thinking Bezos has been. After 15 years near the top of the tech heap, he doesn't have the same outsize profile of other internet innovators. Nobody has made a TV biopic or Academy Award-winning drama about his rise to power, for instance. But that may be changing. People are slowly beginning to realise just how much of the web is powered by Amazon's cloud services. And industry observers see Amazon's entry into the tablet sweepstakes as further evidence that Bezos may well be the premier technologist in America, a figure who casts as big a shadow as legends such as Bill Gates and Steve Jobs.

In a series of interviews in Seattle and New York, Bezos sat down with WIRED to share his thoughts on the cloud, commerce, management and outer space.

LEVY: The Fire seems like more than merely another iPad competitor.

BEZOS: Yeah. What we really built is a fully integrated media service. Hardware is a crucial ingredient in the service, but it's only a piece of it.

Price is a piece of it, too, and yours costs just $199 [in the US].

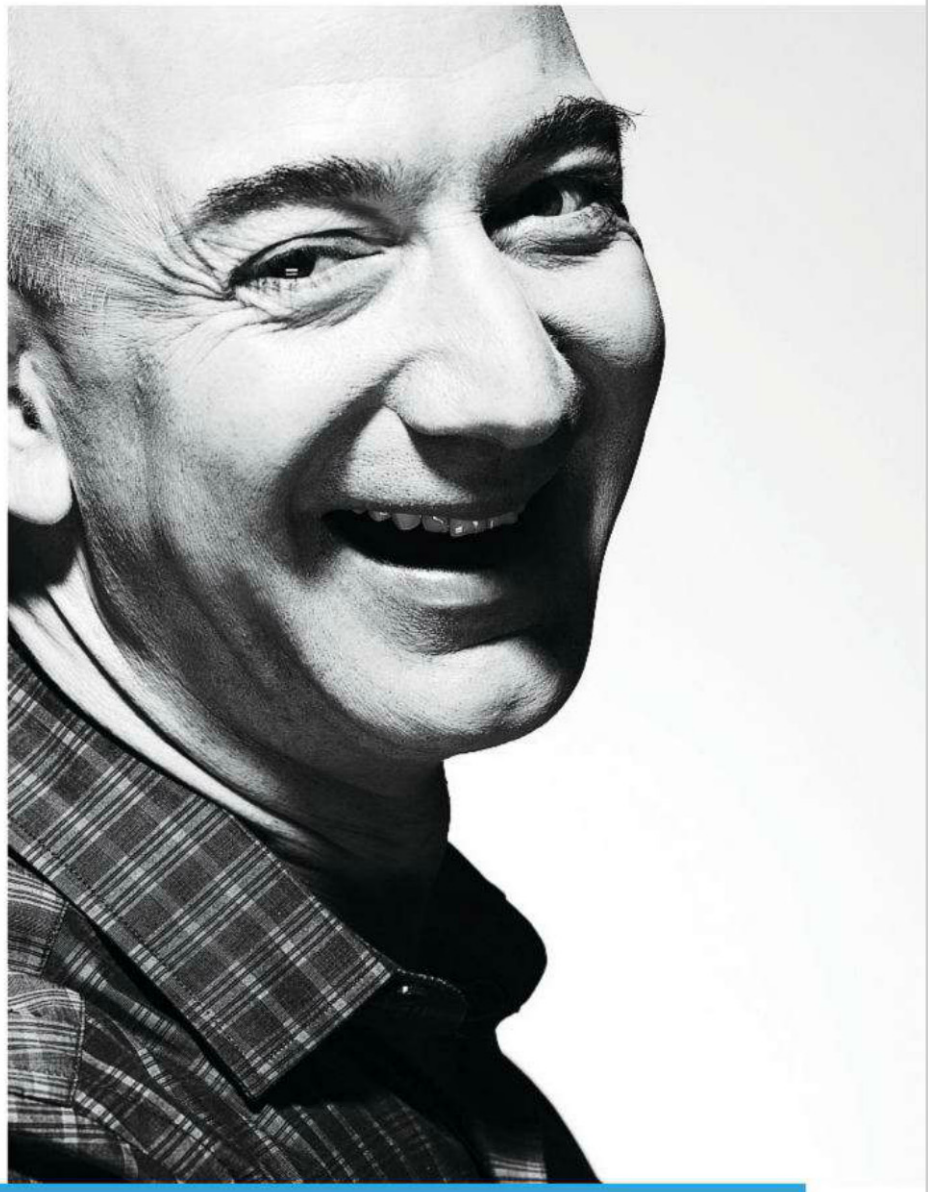
We think it's a unique approach – premium products at non-premium prices. We're a company very accustomed to operating at low margins. We grew up that way. We've never had the luxury of high margins, there's no reason to get used to it now.

How has Amazon been able to reinvent itself so consistently over the past 15 years?

As a company, one of our greatest cultural strengths is accepting the fact that if you're going to invent, you're going to disrupt. A lot of entrenched interests are not going to like it. Some of them will be genuinely concerned about the new way, and some of them will have a vested self-interest in preserving the old way. But in both cases, they're going to create noise, and it's easy for employees to be distracted by that. It could be criticism of something that we believe in. It could also be too much praise about something that we're not doing as well as the outside world says we're doing it. We're going to stay heads-down and work on the business.

Eric Schmidt said that there are now four horsemen of technology: Google, Apple, Facebook and you. Do you agree?

If I were making that list I would have a hard time not having Microsoft on it. They've done a lot of innovative things, some of which get overshadowed by their big existing businesses. You look at something like Kinect, it's pretty cool.



As they'll be the first to tell you.
As they should. It's genuine. But one question to ask when you see a list like that is, who would have been on it ten years ago? That will keep you humble. Go back to 1980. Who would you have predicted to be among the four horsemen of the personal-computer era?
IBM.
Right. And Intel, maybe. But you might've had Commodore, too, or Atari. There are always shiny things. A company shouldn't get addicted to being shiny, because shiny doesn't last. You really want something that's much deeper-keeled. You want your customers to value your service. And there are companies that haven't gone through tough times, so they're not really tested.
Amazon has had those tough times – it took years before you made a profit, and your stock fell dramatically as the first tech bubble popped. Are there things that you've done smarter because you went through that crucible?

Kindle Fire customers can seamlessly access Amazon's entire digital library, including books, magazines, TV shows, and movies – as well as a heavily curated version of the Android app store

It's hard to remember how effervescent the bubble was. People who really didn't have any passion for technology or the internet were giving up their careers as doctors and mining internet gold. And when the bubble popped, a meaningful fraction of our people left. They realised they didn't really want to be doing this. Some of them got laid off, some of them left of their own accord. Those were not happy days. This super-valuable person you really liked leaves. So your skin gets thicker. Not just me, but all of the executives who stayed.
To the consternation of publishers, Amazon is now publishing its own books. What are you doing differently?
For one thing, pricing. For your typical consumer book – I'm not talking about textbooks or anything specialised – $9.99 is really the highest price that's reasonable for customers to pay.
Some publishers don't agree with you.
As a company, we are culturally pioneers, and we like to disrupt even our own business. Other companies have different cultures and sometimes don't like to do that. Our job is to bring those industries along. The music industry should be a great cautionary tale: don't let that happen to you. Get ahead of it. I think with books, we have gotten ahead of it, as have some very forward-leaning publishers.
What else are you doing differently from other publishers?
We believe that some of the royalty streams being paid for ebooks are not high enough. That's why, in our Kindle Direct Publishing programme, if you price your book between $2.99 and $9.99, we give you 70 per cent of the revenue.
What plans does Amazon have to produce content in other media?
Well, we have studios.amazon.com. It's a completely new way of making movies. [Amazon crowdsources the production of a "test movie" until it reaches the point where a real studio takes over.] Some would say our approach is unworkable – we disagree.
Amazon Web Services is dominant in hosting – one observer says that you are the Coke of the field, and there's no Pepsi. How did an ecommerce site wind up in the position where it's hosting web powerhouses such as Foursquare, Nasa and Netflix?
About nine years ago we were wasting a lot of time internally because, to do their jobs, our applications engineers had to have daily detailed conversations with our networking-infrastructure engineers. Instead of having this fine-grained co-ordination about every detail, we wanted the data-centre guys to give the apps guys a set of dependable tools, a reliable infrastructure that they could build products on top of. The problem was obvious. We didn't have that infrastructure. So we started building it for our own internal use. Then we realised, "Whoa, everybody who wants to build web-scale applications is going to need this." We figured with a little bit of extra work we could make it available to everybody. We're going to make it anyway – let's sell it.
What was the internal argument against it?
The common question that gets asked in business is, why? That's a good question, but an equally valid question is, why not? This is

a good idea, we have a lot of skills and assets to do this well, we're already going to do it for ourselves – why not sell it, too?

Young startups all tell me that even if Google offers them free hosting, they still want to use Amazon. Why do you think that is?

We were determined to build the best services but to price them at a level that customers couldn't match, even if they were willing to use inferior products. Tech companies always have high margins, except for Amazon. We're the only tech company with low margins.

How did you do it?

We really obsess over small defects. That's what drives up costs. Because the most expensive thing you can do is make a mistake. We can afford to focus on smaller and smaller defects and eliminate them at their root. That reduces cost, because things just work.

Target recently left Amazon Web Services to build its own web infrastructure. Three weeks after launch, a popular promotion took down the site. Did you get some satisfaction from that?

No. Do you know how long we served Target? Ten years. We worked our butts off to serve them extraordinarily well. Some people misunderstood – "Why are you aiding and abetting a competitor?" But they were great partners. We worked hard for two years to help them migrate to the new system. It was the ultimate in friendly divorces. We wanted to see their transition go smoothly. So, no.

They could've used a few more servers, though.

Well, maybe they should've built their new thing on top of AWS.

You've leveraged Amazon Web Services by making use of it in your new Silk browser. Why?

One of the things that makes mobile web browsing slow is the fact that the average site pulls content from 13 different places on the net. On a mobile device, even with a good Wi-Fi connection, each round trip is typically 100 milliseconds or more. Some of that can be done in parallel, but you typically have a whole bunch, as many as eight or more round trips that each takes 100 milliseconds. That adds up. We've broken apart this process. If you can be clever enough to move the computation on to our cloud, you get these huge computational resources. Our cloud services are really fast. What takes 100 milliseconds on Wi-Fi takes less than five milliseconds on Amazon's Elastic Compute Cloud. By moving some of the computation on to that cloud, we can accelerate a lot of what makes mobile web browsing slow.

'WE ARE CULTURALLY PIONEERS. WE LIKE TO DISRUPT EVEN OUR OWN BUSINESS. OTHER COMPANIES HAVE DIFFERENT CULTURES AND SOMETIMES DON'T LIKE TO DO THAT. OUR JOB IS TO BRING THOSE INDUSTRIES ALONG'

Was it difficult to turn yourself from a retail company into a consumer-electronics company?

It's not as different as you might think. A lot of our original approaches and techniques carried over very well. For example, we've always focused on reducing the time between order and delivery. In hardware, it's the same principle. An example is the time between when we take delivery on a processor to when it's being used in a device by a customer. That's waste. Why would we own a processor that's supposed to go into a Kindle Fire that's not actually in a customer's hands? That's inventory management.

By the way, how many Kindles have you sold?

[Bezos gives a long, loud example of his famous laugh.]

You don't even answer!

I know you don't expect me to.

For years you've been touting e-ink as superior to a backlit device for reading. But the Fire is backlit. Why should Kindle users switch?

They should buy both. When you're reading long form, there's no comparison. You want the e-ink. But you can't watch a movie with that. And you can't play Android games. And so on.

And you now are selling a new version of the basic Kindle for $79. At this point, why not give it away – offer a deal where if people buy a certain amount of books, they get a free Kindle?

It's an interesting marketing idea, and we should think about it over time. But $79 is low enough that it's not a big deal for many people.

Speaking of pricing, I wanted to ask about your decision to include streaming video as part of Amazon Prime. Why not charge separately for that? It's a completely different service, isn't it?

There are two ways to build a successful company. One is to work very, very hard to convince customers to pay high margins. The other is to work very, very hard to be able to afford to offer customers low margins. They both work. We're firmly in the second camp. It's difficult – you have to eliminate defects and be very efficient. But it's also a point of view. We'd rather have a very large customer base and low margins than a smaller customer base and higher margins.

Competing visions

The Kindle Fire isn't just a rival to the iPad. It represents an alternative model of computing: it's Apple's post-PC vs Amazon's post-web

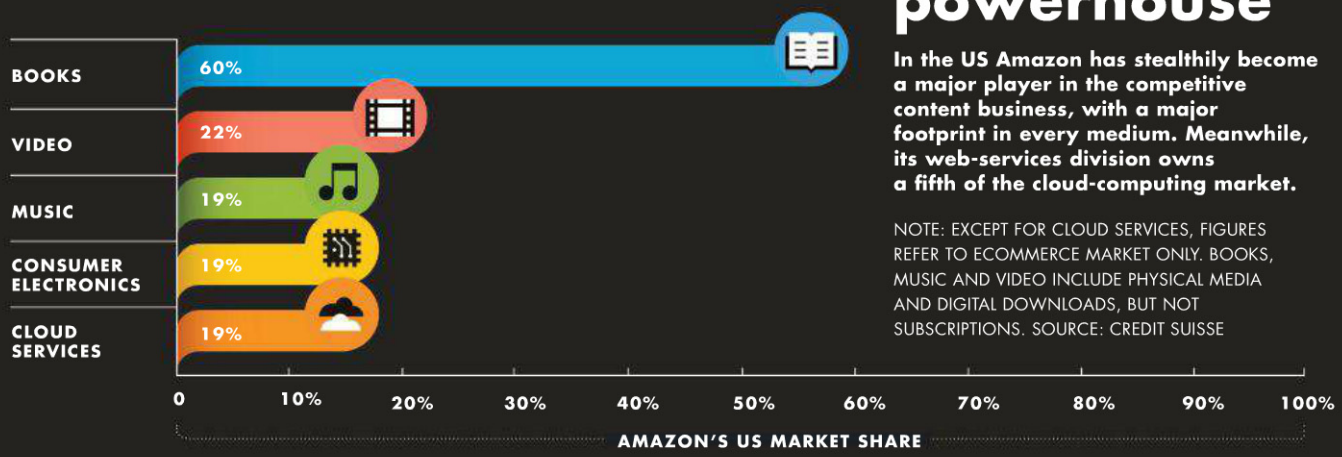
APPLE: POST-PC	AMAZON: POST-WEB
Device-centric	Cloud-centric
Own the OS	Forget the OS
Specialised apps	Specialised browser
Hardware is king	Content is king
Downloaded media	Streamed media

Right now, the more recent movies and TV shows aren't included in the [US] Prime membership. You have to buy or rent them separately. Wouldn't it be better to offer an all-you-can-eat package that includes premium films, even if you have to charge a bit more?
I'm a big fan of all-you-can-eat plans, because they're simpler. We work together with a bunch of different parties – the studios, content owners – and they get a say in how we offer their content, too. But my view is, if you can simplify it for consumers, that's the way to do it.
You've built some social features into Amazon, but it's not a huge part of what you do. What's Amazon's role in the social arena?
It's an open question. I think what we're wondering is, if we have a list of 500 of your friends, how can we use that to improve ecommerce? We have some ideas. We've actually already done some experiments but haven't found anything that we think is exciting yet.
Your rivals treat social interaction as an essential component.
For better or worse, it is really not a part of our culture to look at things defensively. We rarely say, "Oh my God, we've got to do something about that existential threat." Maybe one day we'll become extinct because of that deficiency in our nature. I don't know. We look at things through a different lens. We say, "Oh, here's this incredible phenomenon called social networking. How can we be inspired by that to make our business better?" I hope we find something.
In 2009, you bought [US clothing etailer] Zappos. Was that a bid to absorb their "culture of happiness" and customer service?
No, no, no. We like their unique culture, but we don't want that culture at Amazon. We like our culture, too. Our version of a perfect customer experience is one in which our customer doesn't want to talk to us. Every time a customer contacts us, we see it as a defect. I've been saying for many years people should talk to their friends, not their merchants. So we use all of our customer-service information to find the root cause of any customer contact. What went wrong? Why did that person call? Why aren't they spending that time talking to their family instead? How do we fix it? Zappos takes a completely different approach. You call them and ask them for a pizza, and they'll get out the Yellow Pages for you.
So where's the synergy?
It's on the back end. Amazon has a huge shoe business. Zappos has a huge shoe business. Zappos may have the size-eight customer, and we have the size-eight shoe. Having one set of fulfillment services for these two very different front ends, you get to satisfy more customers more often, because you're more likely to have their size and style and colour and so on.
Some years ago, there was some controversy when Amazon got a patent for its 1-Click shopping. Tech patents are so widespread that they're seen as a hindrance to creativity and innovation. Has your thinking changed?
For years, I've thought software patents should either be eliminated or dramatically shortened. It's impossible to measure the toll they've had on the software industry, but on balance, it's been negative.
But without software patents, you wouldn't have exclusive rights to 1-Click shopping.
If that were the price of having a dramatic reduction in software patents, it would be great.

How Amazon powers the internet

It began as a way for Amazon's engineers to work together efficiently. Now Amazon Web Services hosts some of the most popular sites on the web and is responsible for a significant amount of the world's online traffic. Here's a look at some of the companies that rely on Amazon's cloud-computing platform

CUSTOMER	WHAT IT USES AMAZON WEB SERVICES FOR
Foursquare	3 million check-ins a day
Harvard Medical School	Vast database for developing genome-analysis models
Nasa Jet Propulsion Lab	Processing of hi-res satellite images to help guide its robots
Netflix	Video-streaming service that accounts for 25% of US net traffic
Newsweek/The Daily Beast	1 million page views every hour
PBS	More than 1 petabyte of streaming video a month
SmugMug	Storage for 70 million photos
US Department of Agriculture	Geographic information system for food-stamp recipients
Virgin Atlantic	Crowdsourced travel-review service
Yelp	Data storage for 22 million–plus reviews



Media powerhouse

In the US Amazon has stealthily become a major player in the competitive content business, with a major footprint in every medium. Meanwhile, its web-services division owns a fifth of the cloud-computing market.

NOTE: EXCEPT FOR CLOUD SERVICES, FIGURES REFER TO ECOMMERCE MARKET ONLY. BOOKS, MUSIC AND VIDEO INCLUDE PHYSICAL MEDIA AND DIGITAL DOWNLOADS, BUT NOT SUBSCRIPTIONS. SOURCE: CREDIT SUISSE

You have a separate company called Blue Origin that hopes to send customers into outer space. Why is that important to you?
It is a serious effort. When I was five years old, I watched Neil Armstrong step on to the Moon. It made me passionate about science, physics, maths, exploration.

Will you walk on the Moon some day?
Boy. I've been asked to make tough predictions before. That one's very tough. But that's not what this is about. If I wanted to buy tourist trips to fly to the International Space Station and Soyuz and those things, there's nothing wrong with that. But that's $35 million. I want to lower the cost of access to space.

How do you do that?
I like to say, "Maintain a firm grasp of the obvious at all times." For Amazon, that's selection, speed of delivery, lower prices. For Blue Origin it's cost and safety. If you want to make it so that anybody can go into space, you have to increase the safety and decrease the cost. That's Blue Origin's mission. I'm super-passionate about it.

Do you feel that it's a bit disconnected to start a space-exploration company in this economically grim time?
No. We employ a lot of aerospace engineers. They have families, their kids go to college. We buy a lot of materials. Somebody made those materials, right?

You've also given $42 million to the Long Now Foundation for the development of a giant clock designed to last for 10,000 years. Does that project relate at all to what you're doing at Amazon?
It does fit into my view. Our first shareholder letter, in 1997, was entitled, "It's all about the long term". If everything you do needs to work on a three-year time horizon, then you're competing against a lot of people. But if you're willing to invest on a seven-year time horizon, you're now competing against a fraction of those people, because very few companies are willing to do that. And just by lengthening the time horizon, you can engage in endeavours that you could never otherwise pursue. At Amazon we like things to work in five to seven years. We're willing to plant seeds, let them grow. We say we're stubborn on vision and flexible on details. In some cases, things are inevitable. Ebooks had to happen. Infrastructure web services had to happen. You can do these things with conviction if you are long-term-oriented and patient.

You're still young, but you've been at this for a long time. Many of the other big tech CEOs of your generation aren't around any more.
Don't worry, they'll make more.

But you'll miss Steve Jobs, I assume.
He was a teacher to anyone paying attention. He's gone way too soon.

'WE WORK VERY, VERY HARD TO BE ABLE TO AFFORD TO OFFER CUSTOMERS LOW MARGINS. WE'D RATHER HAVE A VERY LARGE CUSTOMER BASE AND LOW MARGINS THAN A SMALLER CUSTOMER BASE AND HIGHER MARGINS'

What's the right shelf life for a CEO?
It's variable. I like invention. It feels like the rate of change on the internet today is greater than it was in 1995. It's hard to imagine a more exciting arena in which to invent. It's easy to wake up excited. W

Steven Levy wrote about Steve Jobs in 12.11

BY **BENJAMIN WALLACE**

ILLUSTRATION:
JURGEN ZIEWE

THE RISE AND FALL OF BITCOIN

INSIDE THE VIRTUAL CURRENCY YOU CAN ACTUALLY SPEND – IF IT DOESN'T GET STOLEN FIRST

On November 1, 2008, a man named Satoshi Nakamoto posted a research paper to an obscure cryptography listserv describing his design for a new digital currency that he called bitcoin. None of the list's veterans had heard of him, and what little information could be gleaned was murky and contradictory. In an online profile, he said he lived in Japan. His email address was from a free German service. Google searches for his name turned up no relevant information; it was clearly a pseudonym. But while Nakamoto himself may have been a puzzle, his creation cracked a problem that had stumped cryptographers for decades. The idea of digital money – convenient and untraceable, liberated from the oversight of governments and banks – had been a hot topic since the birth of the internet. Cypher-punks, the 90s movement of libertarian cryptographers, dedicated themselves to the project. Yet every effort to create virtual cash had foundered. Ecash, an anonymous system launched in the early 90s by cryptographer David Chaum, failed in part because it depended on the existing infrastructures of government and credit-card companies. Other proposals followed – bit gold, RPOW, b-money – but none had got off the ground.

One of the core challenges of designing a digital currency involves something called the double-spending problem. If a digital dollar is just information, free from the corporeal strictures of paper and metal, what's to prevent people from copying and pasting it as easily as a chunk of text, "spending" it as many times as they want? The conventional answer involved using a central clearing house to keep a real-time ledger of all transactions. The ledger prevents fraud, but it also requires a trusted third party to administer it.

Bitcoin did away with the third party by publicly distributing the ledger, what Nakamoto called the "block chain". Users willing to devote CPU power to running special software would be called miners and would form a network to maintain the block chain collectively. In the process, they would also generate new currency. Transactions would be broadcast to the network, and computers with the software would compete to solve irreversible cryptographic puzzles that contain data from several transactions. The first to solve each puzzle would be awarded 50 new bitcoins, and the associated block of transactions would be added to the chain. The difficulty of each puzzle would increase with the number of miners, keeping production to one block of transactions about every ten minutes. Also, the size of each block bounty would halve every 210,000 blocks – first from 50 bitcoins to 25, then from 25 to 12.5 and so on. Around the year 2140, the currency would reach its pre-ordained limit of 21 million bitcoins.

When Nakamoto's paper came out in 2008, trust in the ability of governments and banks to manage the economy and the money supply was at its nadir. The US government was throwing dollars at Wall Street and the Detroit car companies. Many central banks in the west were introducing "quantitative easing", essentially printing money in order to stimulate the economy. The price of gold was rising. Bitcoin required no faith in the politicians or financiers who had wrecked the economy – just in Nakamoto's elegant algorithms. Not only did bitcoin's public ledger seem to protect against fraud, but the predetermined release of the digital currency kept the bitcoin money supply growing at a predictable rate, immune to printing-press-happy central bankers and Weimar-style hyperinflation.

Nakamoto himself mined the first 50 bitcoins – which came to be called the genesis block – on January 3, 2009. For a year or so, his creation remained the province of a tiny group of early adopters. But slowly, word of bitcoin spread beyond the insular world of cryptography. It has won accolades from some of digital currency's greatest minds. Wei Dai, inventor of b-money, calls it "very significant"; Nick Szabo, who created bit gold, hails bitcoin as "a great contribution to the world"; and Hal Finney, the eminent cryptographer behind RPOW, says it's "potentially world-changing". The Electronic Frontier Foundation, an advocate for digital privacy, eventually started accepting donations in the alternative currency.

The small band of early bitcoiners all shared the communitarian spirit of an open-source-software project. Gavin Andresen, a coder in New England, bought 10,000 bitcoins for $50 (£32) and created a site called the Bitcoin Faucet, where he gave them away for the hell of it. Laszlo Hanyecz, a Florida programmer, conducted what bitcoiners think of as the first real-world bitcoin transaction, paying 10,000 bitcoins to get two pizzas delivered from Papa John's. (He sent the bitcoins to a volunteer in England, who then made a credit-card order transatlantically.) A farmer in Massachusetts named David Forster began accepting bitcoins as payment for alpaca socks.

The faithful tried to solve the mystery of the man they called simply Satoshi. On a bitcoin IRC channel, someone noted portentously that in Japanese Satoshi means "wise". Someone else wondered whether the name might be a sly portmanteau of four tech companies: SAmsung, TOSHIba, NAKAmichi and MOTOrola. It seemed doubtful that Nakamoto was even Japanese. His English had the flawless, idiomatic ring of a native speaker. Perhaps, it was suggested, Nakamoto wasn't one man but a mysterious group with an inscrutable purpose.

"I exchanged some emails with whoever Satoshi supposedly is," says Hanyecz, who was on bitcoin's core developer team for a time. "I'd get replies maybe every two weeks, as if someone would check it once in a while. But bitcoin seems awfully well designed for one person to crank out." Nakamoto revealed little about himself, limiting his online utterances to technical discussion of his source code. On December 5, 2010, after bitcoiners started to call for WikiLeaks to accept bitcoin donations, the normally terse Nakamoto weighed in with uncharacteristic vehemence. "No, don't 'bring it on,'" he wrote in the bitcoin forum. "The project needs to grow gradually so the software can be strengthened along the way. I make this appeal to WikiLeaks not to try to use bitcoin. Bitcoin is a small beta community in its infancy. You would not stand to get more than pocket change, and the heat you would bring would likely destroy us at this stage."

Then, as unexpectedly as he had appeared, Nakamoto vanished. At 6.22 pm GMT on December 12, seven days after his WikiLeaks plea, he posted his final message to the bitcoin forum. His email responses became erratic, then stopped. Andresen, who had taken over the role of lead developer, was now one of just a few people with whom he still communicated. On April 26, Andresen told fellow coders: "Satoshi did suggest this morning that I (we) should try to de-emphasise the whole 'mysterious founder' thing when talking publicly about bitcoin." Then Nakamoto stopped replying even to Andresen's emails. Bitcoiners wondered plaintively why he had left them. But by then his creation had taken on a life of its own.

Bitcoin enthusiasts are almost evangelists," Bruce Wagner says. "They see the beauty of the technology. It's a huge movement. It's almost like a religion. On the forum, you'll see the spirit. It's not just me, me, me. It's what's for the betterment of bitcoin." It's a July morning. Wagner, whose boyish energy belies his 50 years, is sitting in his office at OnlyOneTV, an internet-TV startup in Manhattan. Over just a few months, he has become bitcoin's chief proselytiser.

◆ **PLAY DOUGH**
KEY MOMENTS IN THE SHORT AND VOLATILE LIFE OF BITCOIN

Bitcoin evangelist Bruce Wagner at one of the few New York restaurants that accept the currency

He hosts *The Bitcoin Show*, a programme in which he plugs the nascent currency and interviews notables from the bitcoin world. He also runs a bitcoin meetup group and is gearing up to host bitcoin's first "world conference" in August. "I got obsessed and didn't eat or sleep for five days," he says, recalling the moment he discovered bitcoin. "It was bitcoin, bitcoin, bitcoin, like I was on crystal meth!" Whereas bitcoin is "the most exciting technology since the internet," he says, eBay is "a giant bloodsucking corporation" and free speech "a popular myth". He is also excitable when predicting the future of bitcoin. "I knew it wasn't a stock and wouldn't go up and down," he explains."This was something that was going to go up, up, up."

For a while, he was right. Until early 2010, bitcoins had no value at all, and for the first six months after they started trading in April 2010, the value of one bitcoin stayed below 14 cents (9p). Then, as the currency gained viral traction in summer 2010, rising demand for a limited supply caused the price on online exchanges to start moving. By early November, it surged to 36 cents before settling down to around 29 cents. In February 2011, it rose again and was mentioned on Slashdot for achieving "dollar parity"; it hit $1.06 before settling down at roughly 87 cents.

In the spring, catalysed in part by a much-linked *Forbes* story on the new "crypto currency", the price exploded. From early April to the end of May, the going rate for a bitcoin rose from 86 cents to $8.89. Then, after Gawker published a story on June 1 about the currency's popularity among online drug dealers, it more than tripled in a week, soaring to about $27. The market value of all bitcoins in circulation was approaching $130 million. A Tennessean dubbed KnightMB, who held 371,000 bitcoins, became worth more than $10 million, the richest man in the bitcoin realm. The value of those 10,000 bitcoins Hanyecz used to buy pizza had risen to $272,329. "I don't feel bad about it," he says. "The pizza was really good."

Bitcoin was drawing the kind of attention normally reserved for overhyped Silicon Valley IPOs and Apple launches. Prominent venture capitalist Fred Wilson heralded "societal upheaval" as the Next Big Thing on the internet, and the four examples he gave were WikiLeaks, PlayStation hacking, the Arab Spring and bitcoin. Andresen accepted an invitation from the CIA to speak about the currency. Rick Falkvinge, founder of the Swedish Pirate Party (whose central policy plank includes the abolition of the patent system), announced that he was putting his life savings into bitcoins.

The future of bitcoin seemed to shimmer with possibility. Mark Suppes, an inventor building a fusion reactor in a Brooklyn loft from eBay-sourced parts, got an old ATM and began retrofitting it to dispense cash for bitcoins. On the so-called secret internet (the invisible grid of sites reachable by computers using Tor anonymising software), the black-and-grey-market site Silk Road anointed the bitcoin the coin of the realm; you could use bitcoins to buy everything from Purple Haze pot to a kit for converting a rifle into a machine gun. A young bitcoiner, The Real Plato, brought *On the Road* into the new millennium by video-blogging a cross-country car trip during which he spent only bitcoins. Numismatic enthusiasts among the currency's faithful began dreaming of collectible bitcoins, wondering what price such rarities as the genesis block might fetch.

As the price rose and mining became more popular, the increased competition meant decreasing profits. An arms race commenced. Miners looking for horsepower supplemented their computers with more powerful graphics cards, until they became nearly impossible to find. Where the first miners had used their existing machines, the new wave, looking to mine bitcoins 24 hours a day, bought racks of cheap computers with high-speed GPUs cooled by noisy fans. The boom gave rise to mining-rig porn, as miners posted photos of their setups. As in any gold rush, people recounted tales of uncertain veracity. An Alaskan named Darrin reported that a bear had broken into his garage but thankfully ignored his rig. Another miner's electric bill ran so high, it was said, that police raided his house, suspecting that he was growing pot.

Amid the euphoria, there were troubling signs. Bitcoin had begun in the public-interested spirit of open-source

PHOTOGRAPHY: MICHAEL SCHMELLING.
GRAPH SOURCE: BITCOINCHARTS.COM (AS AT OCTOBER 19, 2011)

peer-to-peer software and libertarian political philosophy. But real money was at stake now, and the dramatic price rise had attracted a different element, people who saw the bitcoin as a commodity in which to speculate. At the same time, media attention was bringing exactly the kind of heat that Nakamoto had feared. US senator Charles Schumer held a press conference, appealing to the DEA and Justice Department to shut down Silk Road, describing bitcoin as "an online form of money laundering". Meanwhile, a cult of Satoshi was developing. Someone started selling "I Am Satoshi Nakamoto" T-shirts. There was Satoshi-themed fan fiction and manga art. And bitcoiners continued to ponder his mystery. A few postulated he was WikiLeaks founder Julian Assange. Many more were convinced that he was Gavin Andresen. Still others believed that he must be one of the older crypto-currency advocates – Finney or Szabo or Dai. Szabo himself suggested it could be Finney or Dai. Stefan Thomas, a Swiss coder and active community member, graphed the time stamps for each of Nakamoto's 500-plus bitcoin forum posts; the chart showed a steep decline to almost no posts between the hours of 5am and 11am Greenwich Mean Time. Because this pattern held true even on Saturdays and Sundays, it suggested that the lull was occurring when Nakamoto was asleep, rather than at work. (The hours of 5am to 11am GMT are midnight to 6am Eastern Standard Time in the US.) Other clues suggested that Nakamoto was British: a newspaper headline he had encoded in the genesis block came from *The Times*, and both his forum posts and his comments in the bitcoin source code used such British spellings as "optimise" and "colour".

Both the code and the idea of bitcoin may have been impregnable, but bitcoins themselves – unique strings of numbers that constitute units of the currency – are discrete pieces of info that have to be stored somewhere. By default bitcoin kept users' currency in a digital "wallet" on their desktop, and when bitcoins were worth very little, easy to mine and possessed only by techies, that was sufficient. But once they became valuable, a PC felt inadequate. Some users protected bitcoins by creating multiple backups, encrypting and storing them on thumb drives, on forensically scrubbed virgin computers without internet connections, in the cloud, and on printouts stored in safe-deposit boxes. But even some sophisticated early adopters had trouble keeping their bitcoins safe. Stefan Thomas had three copies of his wallet yet inadvertently managed to erase two of them and lose his password for the third. In a stroke, he lost about 7,000 bitcoins, at the time worth about $140,000. "I spent a week trying to recover it," he says. "It was pretty painful."

SOME PEOPLE BEGAN TO SUSPECT BITCOIN WAS THE WORK OF THE CIA OR THE FEDERAL RESERVE – OR EVEN A PONZI SCHEME

Most people who have cash to protect put it in a bank, an institution about which the more zealous bitcoiners were deeply wary. Instead, for this new currency, a primitive and unregulated financial-services industry began to develop. Fly-by-night online "wallet services" promised to safeguard clients' digital assets. Exchanges allowed anyone to trade bitcoins for dollars or other currencies. Bitcoin itself may have been decentralised, but users were now blindly entrusting increasing amounts of currency to third parties that even the most libertarian would be hard-pressed to claim were more secure than federally insured institutions.

Sure enough, as the price headed upwards, disturbing events began to bedevil the bitcoiners. In mid June, someone calling himself Allinvain reported that 25,000 bitcoins worth more than $500,000 had been stolen from his computer. (To this day, it has not been proven whether this claim is true.) About a week later, a hacker pulled off an ingenious attack on a Tokyo-based exchange site called Mt. Gox, which handled 90 per cent of all bitcoin exchange transactions. Mt. Gox restricted account withdrawals to $1,000 worth of bitcoins per day (at the time of the attack, roughly 35 bitcoins). After he broke into Mt. Gox's system, the hacker simulated a massive sell-off, driving the exchange rate to zero and letting him withdraw potentially tens of thousands of other people's bitcoins.

As it happened, market forces conspired to thwart the scheme. The price plummeted, but as speculators flocked to take advantage of the fire sale, they quickly drove it back up, limiting the thief's haul to only around 2,000 bitcoins. The exchange ceased operations for a week and rolled back the post-crash transactions, but the damage had been done; the bitcoin never got back above $17. Within a month, Mt. Gox had lost ten per cent of its market share to a Chile-based upstart named TradeHill. The incident had shaken the confidence of the community and inspired a flurry of bad press.

In the public's imagination, overnight the bitcoin went from being the currency of tomorrow to a dystopian joke. The Electronic Frontier Foundation quietly stopped accepting bitcoin donations. Two Irish scholars specialising in network analysis demonstrated that bitcoin wasn't nearly as anonymous as many had assumed: they were able to identify the handles of a number of people who had donated to WikiLeaks. (The organisation announced in June 2011 that it was accepting such donations.) Non-technical newcomers to the currency, expecting it to be easy to use, were disappointed to find that an extraordinary amount of effort was required to obtain, hold and spend bitcoins. For a time, one of the easier ways to buy them was to first use Paypal to buy Linden dollars, the virtual currency in *Second Life*, then trade them there for bitcoins. As the tone of media coverage shifted to sceptical, attention that had once been thrilling became a source of resentment.

More disasters followed. Poland-based Bitomat, the third-largest exchange, revealed that it had – oops – accidentally overwritten its entire wallet. Security researchers detected a proliferation of viruses aimed at bitcoin users: some were designed to steal wallets full of existing bitcoins; others commandeered processing power to mine fresh coins. By summer, the oldest wallet service, MyBitcoin, stopped responding to emails. But after a month of unbroken silence, Wagner, the bitcoin evangelist, finally stated what many had already been thinking: whoever was running MyBitcoin had apparently gone AWOL with everyone's money. Wagner himself revealed that he had been keeping all 25,000 or so of his bitcoins on MyBitcoin and had recommended to friends and relatives that they use it, too. He also aided a vigilante

● HOW THEY'RE MADE

Bitcoin's economy consists of a network of users' computers. At preset intervals, an algorithm releases new bitcoins into the network: 50 every ten minutes, with the pace halving until around 2140. The pace is meant to ensure a steady monetary supply without interference from third parties, which can lead to hyperinflation.

● HOW THEY'RE MINED

To prevent fraud, the software has a pseudonymous public ledger of every transaction. Some bitcoiners' computers validate transactions by cracking cryptographic puzzles; the first to solve each puzzle receives 50 new bitcoins. Bitcoins can be stored in many places – from a "wallet" on a desktop to a centralised service in the cloud.

● HOW THEY'RE SPENT

Once users download the app to their machine, spending is as easy as sending an email. The range of merchants that accept it is growing; look for the telltale symbol at the cash register. Entrepreneurial bitcoiners are working to make it much easier to use, building everything from point-of-service machines to PayPal alternatives.

effort that publicly named several suspects. MyBitcoin's supposed owner resurfaced, claiming his site had been hacked. Then Wagner became the target of a counter campaign that publicised a successful lawsuit against him for mortgage fraud, costing him much of his reputation within the community. "People have the mistaken impression that virtual currency means you can trust a random person over the internet," says Jeff Garzik, a member of bitcoin's core developer group.

And nobody had been as trusted as Nakamoto himself, who remained mysteriously silent as the world he created threatened to implode. Some began to suspect he was working for the CIA or Federal Reserve. Others worried that bitcoin had been a Ponzi scheme, with Nakamoto its Bernie Madoff.

Although the gold-rush phase of mining has ended, with some miners dumping their souped-up mining rigs – "People are getting sick of the high electric bills, the heat and the loud fans," Garzik says – the more serious members of the community have turned to infrastructure. Mt. Gox is developing point-of-sale hardware. Other entrepreneurs are working on PayPal-like online merchant services. Two guys in Colorado have launched Bitcoin-Deals, an etailer offering "over 1,000,000 items". The underworld's use of the bitcoin has matured, too: Silk Road is now just one of many Tor-enabled back alleys, including sites such as Black Market Reloaded, where self-proclaimed hit men peddle contract killings and assassinations.

The vulnerabilities that led to bitcoin's troubles – its dependence on unregulated, centralised exchanges and online wallets – persist. Indeed, the bulk of mining is now concentrated in a handful of huge mining pools, which theoretically could hijack the entire network if they worked in concert. Beyond the hardcore users, scepticism has increased. Stefan Brands, a former ecash consultant and digital-currency pioneer, calls bitcoin "clever" but believes it's structured like "a pyramid scheme" and rewards early adopters.

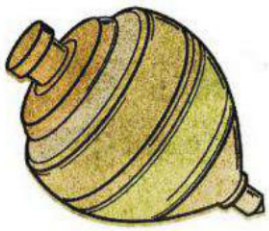
It would be interesting to know what Nakamoto thinks of all this, but he's not talking. The people who might know who he is say they don't. Andresen flatly denies he is Nakamoto. "I don't know his real name," he says. "I'm hoping one day he decides not to be anonymous [pseudonymous] any more, but I expect not." Szabo also denies he is Nakamoto, and so does Dai. Finney, who has blogged about being diagnosed with amyotrophic lateral sclerosis, sent his denial in an email: "Under my current circumstances, facing limited life expectancy, I would have little to lose by shedding anonymity. But it was not I."

The signal in the noise, the figure that emerges from the carpet of clues, suggests an academic with somewhat outdated programming training. (Nakamoto's style of notation "was popular in the late 80s and early 90s," Taaki notes. "Maybe he's around 50, plus or minus ten years.") Some conjecturers are confident in their precision. "He has at best a master's," says a digital-currency expert. "It seems quite obvious it's one of the developers. Maybe Gavin, just looking at his background."

"I suspect Satoshi is a small team at a financial institution," whitehat hacker Dan Kaminsky says. "I just get that feeling. He's a quant who may have worked with some of his friends." But Garzik, the developer, says that the most dedicated bitcoiners have stopped trying to hunt down Nakamoto. "We really don't care," he says. It's not the individuals behind the code who matter, but the code itself. And while people have stolen and cheated and abandoned the bitcoiners, the code has remained true. ■

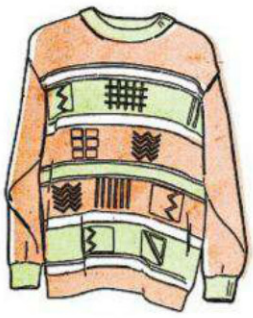
Benjamin Wallace is author of The Billionaire's Vinegar: The Mystery of the World's Most Expensive Bottle of Wine *(Crown)*

ILLUSTRATION: MARTIN VENEZKY



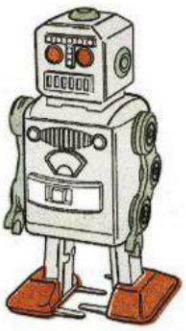
1900's

1920's



1950's

THE SEASON'S GIFT



1970's

1980's

1990's

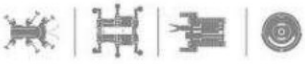
HAS EVOLVED

2000's

2011

Every year, one gift simply cleans up; this year's must-have is Roomba,
the robot that vacuum cleans automatically so you don't have to.

To explore how you can keep the whole family happy this Christmas visit **www.irobot.com**

1990 

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2011

TEST

LAB RESULTS
THIS MONTH: 01.12
- SPACE HEATERS
- MODEL ROCKETS
- PHOTOBOOK SERVICES

EDITED BY
JIM HILL

The Estes Executioner has an aerodynamically streamlined nose cone

PHOTOGRAPHY: WILSON HENNESSY

Prepare for lift-off

WIRED gets fired up and heads for the great blue yonder with the latest self-launch rockets – p158

The Studio G weighs 4.37kg, but it does have a built-in carry handle

EFFECTIVE WARMING DISTANCE

Winter warmers

Electric fan heaters which raise room temperature, but don't burn your money

DIMPLEX STUDIO G DXSTG25

Standing a compact 82.5cm high, the Studio G's speaker-style tower design with LED touch-control panel could easily be mistaken for a sleek hi-fi component. A remote control is supplied for adjusting heat settings between 15°C and 35°C, setting the one- to 12-hour timer and rotating by 76°. Tip-over protection will cut off heat supply if this tall, slightly unstable unit falls. You'll need to remove the air filter on the back to clean it, but that's a pretty small price to pay for such an attractive, living-room-friendly design.

WIRED Remote control
TIRED Unstable form factor
£79.99 argos.co.uk

BIONAIRE BFH912-IUK

This compact digital fan heater emitted a powerful blast of hot air as soon as we switched it on. The LCD display is simple to navigate, enabling us to flick between a wide selection of pre-programmed settings. Scrolling the dial wheel manually adjusts the temperature from 18°C to 30°C. Once activated, the Frost Guard feature automatically turns on the heater when the room temperature drops to 5°C. Its carry handle can be tricky to grip but it does help with portability.

WIRED Best timer on test
TIRED Noisiest fan motor

£45.95 johnlewis.com

DELONGHI HVR9033 RETRO

The body of this easy-on-the-eye fan heater is raised from the floor to make it safer to use on horizontal surfaces. It's also fitted with a safety device that will shut it off in the event of overheating. It includes two settings for high and low power and a cool air-only function, making it good for all seasons. Our tester could maintain the temperature at a touch of a button and tilt the body slightly to adjust the direction of the heat.

WIRED Raised design
TIRED Limited tilting scope

£51.95 johnlewis.com

TEST

DYSON HOT AM04

With no visible heating element or spinning blades, this innovative fan heater uses Dyson's Air Multiplier technology to project heated air rapidly around the room. Raising the temperature higher than the other heaters on test, the Dyson's top setting is 37°. Its base, heated by two ceramic elements, was hot to the touch in use but the upper ring remained cool enough to carry. A safety circuit ensures the heater cuts out if it topples. Its oscillations were smooth and quiet.

WIRED Elegant design
TIRED Considerable cost

£269.99 dyson.co.uk

JCB 3UF

With its durable steel front and black and yellow body, this heavy-duty electric fan heater is ideal for garages and other DIY-style environments. It packs a punch when turned on by its basic dial for instant half heat and full heat – you can then adjust the temperature using the thermostat control. The design also has cool-touch carry handles for easy portability. It features a thermal cutout that switches the heater off should it overheat after prolonged use.

WIRED Impressively powerful
TIRED Cable gets warm

£49.99 homebase.co.uk

HOW WE RATE

1> A complete failure in every way
2> Barely functional – don't buy it
3> Serious flaws – buy with caution
4> Downsides outweigh upsides
5> Recommended with reservations
6> A solid product with some issues
7> Very good, but not quite great
8> Excellent with only a few niggles
9> Nearly flawless – buy it now
10> Metaphysical product perfection

HOW WE TESTED

Assembling five of the latest electric fan heaters, we timed how long it took for each one to raise the ambient temperature by 2°C. We also measured the energy needed to do this and the cost of the electricity required using a household energy meter (the Wattson energy monitor, £99.99, firebox.com), from which our tester was able to calculate their efficiency.

RED-HOT STATS

	DIMPLEX	BIONAIRE	DELONGHI	DYSON	JCB
Dimensions	H82 x W26 x D26cm	H31 x W20 x D20cm	H32 x W31 x D26cm	H58 x W15 x D20cm	H27 x W22 x D16cm
Maximum heat output	2,500W	2,200W	3,000W	2,000W	3,000W
Time taken to raise temp by 2°C	5m 45s	7m 29s	5m 43s	3m 48s	4m 45s
Tested energy usage	2,195W	1,750W	2,500W	1,650W	2,410W
Cost for a rise of 2°C*	3.62p	3.74p	4.13p	1.79p	3.28p

*Measured with cost at 10.343p per unit with Scottish Power (scottishpower.co.uk) for a south-west London home

PHOTOGRAPHY: WILSON HENNESSY. WORDS: EMILY PECK

HOW WE TESTED

With the exception of the Estes Riptide Launch Set, all rockets tested were in kit form and required assembly, glue and finishing supplies, launching equipment and rocket motors. The Ready-to-Fly (RTF) Riptide is sold as a deluxe set including a launch pad, launch controller, batteries, wadding and rocket motors. The SLS Jaguar, Executioner and Long Tom used the Riptide set's ground-support equipment but the Stovi required a more robust launch pad and controller. Assembled according to the manufacturers' instructions and finished economically, the rockets were flown using recommended motors. Flight performance was calculated using rocket-simulation program SpaceCAD.

PROJECTILE TRAJECTORY

	STOVI	EXECUTIONER	RIPTIDE	SLS JAGUAR	LONG TOM
Manufacturer	LOC Precision	Estes	Estes	Semroc	Estes
Length	115cm	98cm	46cm	58cm	84cm
Diameter	78mm	66mm	34mm	31mm	33.5mm
Weight	675g	230g	80g	74g	91g
Motors tested	7 x C11-3	C11-3	B4-4	C11-3	B6-0/A8-5
Max motors	7 x D12-3	D12-5	C6-5	G80-7	C6-0/C6-7
Max altitude	260m	180m	180m	510m	480m
Required ground support	Heavy duty mid-/ high-power pad and controller	Requires standard, plus 5.5mm Maxi Rod	Standard included	Requires standard	Requires standard

ESTES RIPTIDE LAUNCH SET

The Riptide is a quick and cheap starting-point for aspirational rocket jockeys who need to get a handle on aerodynamics, meteorology and the model-rocket safety code. There's no assembly or finishing required to challenge your craftsmanship, making it an ideal gift for space cases of all ages. Even if the wind takes your rocket beyond the horizon or into an unfeasibly tall tree, you'll still have the ground-support equipment for your next leap into the wild blue yonder.

WIRED All-in, out of the box and into the air in minutes

TIRED Heavy; low performance

£29.99 estesrockets.com

TEST

LOC PRECISION STOVI

The big Stovi hits the upper limits of model rocketry even using standard D motors – although it does fire seven of them at once. Igniting clusters such as these is a challenge because of the risk of asymmetric thrust: when one or more motors don't catch, there could be trouble. Assembling the six-finned Stovi was similar to building smaller models but it did require the use of epoxy glue as the components are heavier. The rocket has a substantial payload bay for stowing GPS, altimeters and cameras.

WIRED Soars aloft on a pillar of smoke and flame; easy to build despite size

TIRED Launch is expensive

£57.99 shop.locprecision.com

ESTES EXECUTIONER

The Executioner is a bulky rocket, meaning more room for ungainly payloads such as digital video cameras. Unfortunately, this also means its frontal area adds significant drag – the enemy of altitude. It has many characteristics usually found on larger hobby rockets in the mid- and high-power categories, but assembling it is more of a challenge than need be. The body-tube slots were too small for the thicker, upgraded fin material, which took time to correct. But a good launch result is still possible with care.

WIRED Can carry a DV camera

TIRED Not going to set any speed or altitude records; tricky to build

£27.99 modelrockets.co.uk

SEMROC SLS JAGUAR

If speed and altitude are driving your interest in model rocketry, the SLS Jaguar is for you. Built from heavier-duty components than the mass market Estes kits, it features a pre-slotted body tube for accurate fin alignment. It's usually launched using C or D engines, but a few tweaks will enable you to fly the SLS Jaguar on 29mm E, F or G ammonium perchlorate (AP) motors, climbing higher than 900 metres – once the exclusive territory of the armed forces.

WIRED Flies as fast and high as you want (or dare); easy build

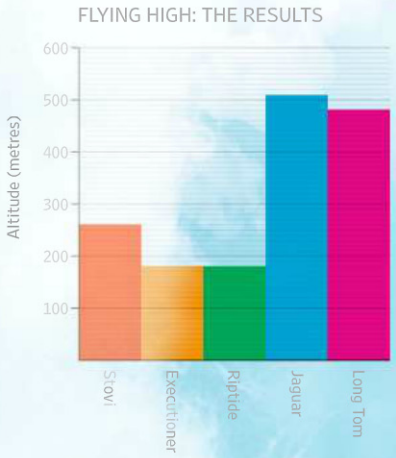
TIRED Motors above D are more difficult to obtain and expensive

£19.99 semroc.com

PHOTOGRAPHY: WILSON HENNESSY; DAVE LIDWELL. WORDS: PAUL LEVIN

The WIRED launch party

We light the fuse and stand back with a selection of domestic model rockets



ESTES LONG TOM

Long Tom sets its altitude benchmark like a real, space-bound rocket by using multiple stages. The booster stage kicks the rocket off the pad, then that stage – along with its spent motor's weight and drag – are jettisoned when the sustainer upper stage is lit. The upper stage can also be flown on its own.

The rocket is made of balsa wood and lightweight fibre-board tubing, and so close attention to assembly is necessary for its eight fins to gain maximum performance. A range of motors is available to tailor your flight to suit conditions.

WIRED Reached the highest altitude of those tested with standard motors

TIRED Booster stage can be a recovery challenge; demanding build

£16.99 modelrockets.co.uk

Blurb offers paper swatches to help you decide on the finish

Memory upgrade

Photo-books turn snaps into coffee-table tomes. WIRED proofs the prints

BLURB

This popular photo-book service offered the widest choice of editing options and a very slick interface that makes browsing and choosing your photos fun. However, it offers so many themes and options that this editing process took us the longest of any that we tried out.

Our ProLine book, printed on high-quality pearlescent paper, depicted sharp images that were let down only by an overly warm tone that made the subjects look sunburnt. It's a pity that the poor colour balance spoilt an otherwise excellent coffee-table-quality book.

WIRED: Linen cover with glossy dust jacket looks and feels great

TIRED: Can't upload images 10MB or bigger; expensive

●●●●●●●●●●

From £7.95 (ours cost £62.92 for 24 pages) blurb.com/uk

SNAPFISH

This service currently includes 30 free loose prints, but any benefit from extras such as this is outweighed by poor execution. The clunky user interface means ordering takes longer than the other services, and it has an infuriating habit of timing out if you dawdle. The editing suite offers plenty of garish themes, but a simple, plain background is, apparently, too much to ask for.

The hardback book feels sturdy, but the pictures suffer from washed-out colours – some of the guests in the wedding shots look more like ghosts.

WIRED: Imports directly from Flickr

TIRED: Archaic user interface; no options for minimalist designs

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From £19.99 (ours cost £24.99 for 24 pages) snapfish.co.uk

BONUSPRINT

Spending just 20p extra per page pays for high gloss pages with Bonusprint. This lustrous finish and high print quality made these photos stand out among the other budget services. The book itself was bound in the same size and style of hardback as the one that was available from Snapfish.

Our tester had no trouble editing, designing and uploading the images using Bonusprint's downloadable or online software. On the negative side, the paper pages felt a little thin.

WIRED: Inexpensive gloss finish makes the colours pop

TIRED: Thin paper stock feels cheap

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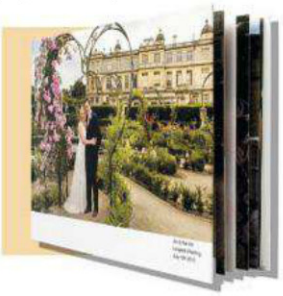
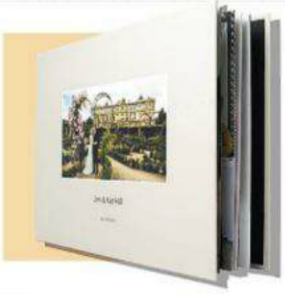
From £9.99 (ours cost £24.99 for 24 pages) bonusprint.co.uk





PHOTOBOX

Ignoring the intrusive logo on the back cover, PhotoBox excelled in making a premium-quality book with plenty of editing features. The texture of the paper stock and the cover felt more expensive than the other books, and the cover photo had a high dynamic range (HDR) feel. It's not perfect, though. Our digital and film pictures could all have used a little more contrast to distinguish the guests' features in the darker shots.

WIRED: Heavy paper stock, thick card cover and sharp print quality

TIRED: User interface is fiddly and unintuitive to use

●●●●●●●●●●●

From £5.99 (ours cost £50.97 for 24 pages) photobox.co.uk

HOW WE TESTED

We used the product editor's wedding photos* to assess the service provided by five popular online photo-book services. The same batch of 30 test photos (a variety of Raw files and film negatives converted to JPEG) were edited and uploaded by our tester. The professional eyes of WIRED's art director were then enlisted to assess print quality and execution of the finished design in each case.

****The wedding was genuine and not carried out purely for the purposes of the test***

APPLE

Created within iPhoto, Apple's photo book was the easiest to edit and produce. It also offered the widest range of themes to create your design. The template allows you to place up to 16 pictures on each page, and there is a choice of book sizes. A system glitch meant that the delivery was delayed slightly, but the final book was printed to a very high standard.

WIRED: Easiest service by far; non-cheesy backgrounds

TIRED: Mac OS X-only

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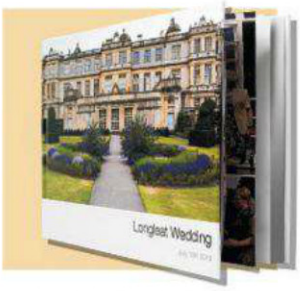
From £2.99 (ours cost £25.58 for 24 pages) apple.com/uk



PRINT PROCESSING

	BLURB	SNAPFISH	BONUSPRINT	PHOTOBOX	APPLE
Colour reproduction	6/10	6/10	8/10	7/10	9/10
Sharpness	6/10	4/10	8/10	7/10	8/10
Editing software	8/10	3/10	7/10	5/10	10/10
Bind quality	8/10	3/10	3/10	7/10	9/10
Production and shipping time	7 – 10 working days	3 – 5 working days	7 working days	6 working days	1 – 5 working days

PHOTOGRAPHY: WILSON HENNESSY. WORDS: KAT HANNAFORD

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Published by Condé Nast Independent Magazines (Pty) Ltd: House & Garden, GQ, Glamour

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This month: overheard in the WIRED office (1): "What are you if you come from Belgium?" **Overheard (2), the art desk to the picture desk:** "If this guy can shoot dogs and horses, he can definitely shoot a person." **Overheard (3), art director to himself, one hour before attending BSME magazine awards, for which he was shortlisted:** "I need a new shirt for tonight, but I don't want to get one because it might always remind me of not winning." (He won).

Number of staffers who took part in Movember: 14
Staffers complaining each day of shaving rash or "angry chin skin": 14

INSIDE WIRED:

WHAT'S THAT NOISE? RECENT iPAD AUDIO CLIPS, RATED BY ANNOYANCE

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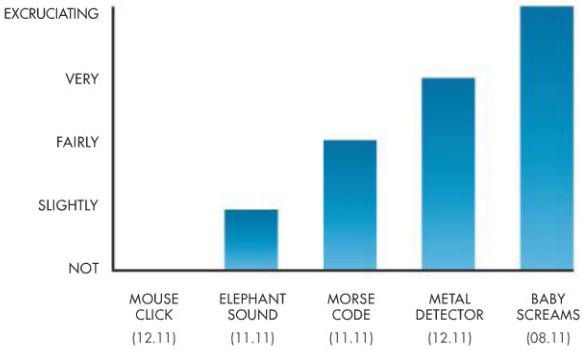

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Sources for the WIRED Index (p29): [1] Wittchen, HU et al *Eur. Neuropsychopharmacol.* 21, 655-679 (2011) [2] Robert Krulwich, "What's the world's favourite number?", NPR.org, 22/07/11 [3] Bessen et al, "The Private and Social Costs of Patent Trolls", *Boston Univ. School of Law, Law and Economics Research Paper* No. 11-45, September 2011 [4] 1000memories.com, 15/09/11 [5] "A day without media", ICMPA, April 2010 [6] Elena Berton, "Dress to Impress", *Wall Street Journal*, 14/12/10 [7], [8] www.hiberniaatlantic.com/construction.html

Sources for Labnotes (p47): [1] Ijzerman, H 2009 "The Thermometer of Social Relations: Mapping Social Proximity on Temperature", *Psychological Science*, vol. 20 issue 10, pp1214-1220 [2] Murray, K 2011 "The effect of weather on consumer spending", *Journal of Retailing and Consumer Services* [3] Connolly, M 2008 "Here Comes the Rain Again: Weather and the Intertemporal Substitution of Leisure", *Journal of Labor Economics* [4] Simonsohn, U 2009 "Weather To Go To College", *The Economic Journal* [5] Redelmeier, "Rainy weather and medical school admission interviews", *CMAJ* [6] Anderson C, 1989 "Temperature and Aggression: Ubiquitous Effects of Heat on Occurrence of Human Violence", *Psychological Bulletin*

Sources for wooga statistics (p139), by column: New Zoo 2011 UK National Gaming Survey; ibid; PopCap Social Gaming Research 2010. Facebook Statistics; AllFacebook; Appdata. *The US Virtual Goods Market*; Parks Associates; New Zoo, op cit. All data in fourth column widely reported

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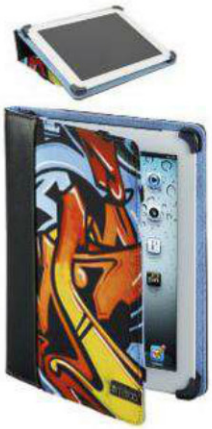

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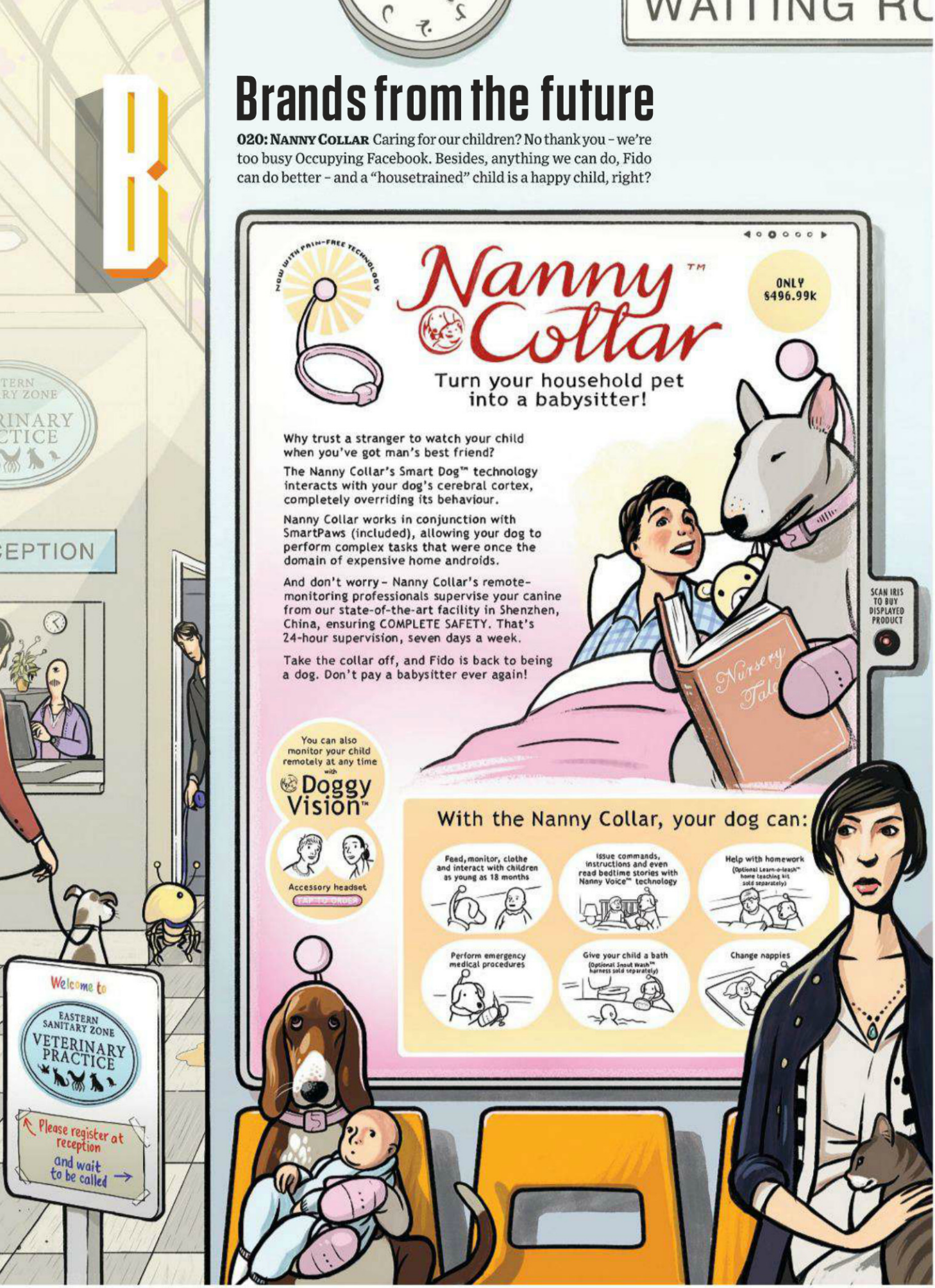

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